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MORPHOLOGY AND TAXONOMY OF THE KNOWN PUPAE OF COCCINELLIDAE (COLEOPTERA) OF NORTH AMERICA, WITH A DISCUSSION OF PHYLOGENETIC RELATIONSHIPS

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ABSTRACT

The structure of the pupae of 32 known genera and 49 species from 11 tribes of coccinellid pupae (mainly of North America) which are positively associated with adults either by collecting in the field or by rearing in the laboratory have been studied and described. Keys to known subfamilies, tribes, genera and species are presented. Based on the pupal characters, the tribal relationships within the family are discussed.

The COCCINELLINAE (Coccinellini and Psylloborini) are highly advanced with very little connection with the remainder of the family. The remainder of the family is grouped in a separate stem with EPILACHNINAE splitting off very early and acquiring highly modified structures to fit their exclusively phytophagous habit.

The COCCIDULINAE (Coccidulini and Scymnillini) and the STICHOLOTINAE (Sticholotini and Serangiini) are regarded as being the most primitive groups, and are closely related. Thus, they are grouped on the same stem of the phylogenetic tree. The Coccidulini (=Rhizobiini) are more closely related to the EPILACHNINAE than any other groups of COCCINELLIDAE.

The CHILOCORINAE (Chilocorini) show some relationships with the STICHOLOTINAE and the SCYMNINAE, but independently evolved on a distinct stem.

The SCYMNINAE (Stethorini, Scymnini and Hyperaspini) have recently evolved. The Hyperaspini appear to be more primitive compared with Scymnini and Stethorini. The Stethorini are considered to be the most highly evolved within the SCYMNINAE, and have the closest affinity to the Chilocorini.

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INTRODUCTION

The morphology of immature insects, especially of holometabolous groups, is an additional source of taxonomic information which unfortunately has not been used for many groups. According to Van Emden (1957) immature characters may be significant in the separation of sibling species, and may help to confirm or to reorganize the classification and phylogeny of groups of insects which have previously been classified only upon adult characters.

The classification of the family Coccinellidae has been based largely on the morphology of adults and larvae. The pupae of Coccinellidae have been little studied. There have been a few short notes or brief descriptions on the morphology, but often only for a single species. This morphological study of the pupae has provided another source of data for more precisely understanding and interpreting the relationships and the natural classification within the family.

Coquillet (1889), Gorham (1892), Pinto da Fonseca and Autuore (1931), Kanervo (1941), Kapur (1943), Kesten (1969), and Marthur and Srivastava (1966) have briefly described the pupae of *Vedalia cardinalis* (Mulsant), *Orcus coeruleus* (Mulsant), *Calvia 15-punctata* Fabricius, *Solanophila candestina* (Mulsant), *Thea bisoctonotata* Mulsant, *Anatis ocellata* Linnaeus, *Stethorus gilvifrons* Mulsant, and *Hyperaspis vinciguerrae* Capra.

Palmer (1914) studied a group of common coccinellid species and provided brief descriptions of the pupae of *Hippodamia convergens* Guerin, *Hippodamia sinuata* Mulsant, *Hippodamia parenthesis* (Say), *Coccinella 5-notata* Kirby, *Coccinella monticola* Mulsant, *Coccinella sanguinea* Linnaeus, and *Olla abdominalis* (Say).

Binaghi (1941) has carefully studied the pupae of the Chilocorini. He offered a key to genera and the species *Chilocorus bipustulatus* Linnaeus, *Exochomus 4-pustulatus* Linnaeus, *Exochomus auritus* Scriba, *Exochomus nigripennis* Erichson, and *Exochomus sjodstedti* Weise.

Recently, Savoiskaya (1962a) has redescribed the pupae of the tribe Chilocorini. Three genera were taxonomically separated (*Chilocorus* L., *Brumus* Muls., and *Exochomus* Redt.) and the following species were described: *Brumus 8-signatus* Gebl., *Chilocorus bipustulatus* Linnaeus, *Exochomus flavipes* Thunberg, *Exochomus melanocephalus* Zubk., and *Exochomus semenovi* Weise.

Savoiskaya (1962c) has also described and studied the larvae and pupae of the genus *Coccinula* Dobzhansky. He prepared a key separating the pupae of the genus *Coccinula,* including the following species: *C. redimita* Weise, *C. 14-pustulata* Linnaeus, *C. sinuato-marginata* Faldermann, and *C. elegantula* Weise.

CLASSIFICATION OF COCCINELLIDAE

Modified from Sasaji (1971)

(*) indicates tribe with available pupae

STICHOLOTINAE

- Sukunahikonini
- Serangiini (*)
- Sticholotini (*)
- Shirozuellini

COCCIDULINAE

- Lithophilini
- Coccidulini (*)
- Scymnillini (*)
- Exoplectrini
- Noviini (*)

EPILACHNINAE

- Epilachnini (*)

SCYMNINAE

- Hyperaspini (*)
- Scymnini (*)
- Stethorini (*)
- Cranophorini
- Aspidimerini
- Ortaliini

CHILOCORINAE

- Telsimiini
- Platynaspini
- Chilocorini (*)

COCCINELLINAE

- Psylloborini (*)
- Coccinellini (*)
- Discotomiini

METHODS OF STUDY AND SOURCES OF MATERIAL

The specimens examined were mainly from the U.S. National Museum and from the rearing program carried on throughout the study. Pupae obtained by rearing are preferred since identifications are positive. Pupae collected in association with adults

in the field are not as positively identified as reared specimens; however, it is an excellent way to get a lot of material with minimal effort. The latter method can best be used if the adults are allowed to emerge, and the pupal exuviae are associated with the newly emerged adult. Not only can the specimens be correctly identified this way, but the exuviae can be examined almost as well as the pupa itself.

In addition to the above material, several important pupae have been obtained from Kenneth S. Hagen, University of California, Berkeley, California; Robert E. Waites, University of Florida, Gainesville, Florida; Roland W. Portman, University of Idaho, Moscow, Idaho and Raymond D. Eikenbary, Oklahoma State University, Stillwater, Oklahoma.

The following pupae were available for this study:

STICHOLOTINAE

Delphastus pusillus (Leconte) (Serangiini)
Microweisea ovalis (Leconte) (Sticholotini)

COCCIDULINAE

Rhizobius ventralis (Erichson) (Coccidulini)
Lindorus lophantae Blaisdell (Coccidulini)
Rodolia cardinalis Mulsant (Noviini)
Zagloba ornata (Horn) (Scymnillini)

EPILACHNINAE

Epilachna varivestis Mulsant (Epilachnini)
Epilachna borealis (Fabricius) (Epilachnini)
Epilachna sp. (Epilachnini)

SCYMNINAE

Scymnus creperus Mulsant (Scymnini)
Cryptolaemus montrouzieri Mulsant (Scymnini)
Hyperaspis binotata (Say) (Scymnini)
Hyperaspis cincta Leconte (Scymnini)
Hyperaspis lateralis Leconte (Scymnini)
Hyperaspis octavia Casey (Scymnini)
Hyperaspis oculaticauda Casey (Scymnini)
Hyperaspis postica Leconte (Scymnini)
Hyperaspis psyche Casey (Scymnini)
Hyperaspis quadrioculata (Motschulsky) (Scymnini)
Hyperaspis quadrivittata Leconte (Scymnini)
Thalassa montezumae Mulsant (Hyperaspini)
Stethorus atomus Casey (Stethorini)
Stethorus picipes Casey (Stethorini)
Stethorus punctum LeConte (Stethorini)

CHILOCORINAE

Chilocorus bivulnerus Mulsant (Chilocorini)
Orcus chalybeus (Boisd.) (Chilocorini)

Axion plagiatum (Olivier) (Chilocorini)
Axion tripustulatum (DeGeer) (Chilocorini)
Exochomus hoegei Gorham (Chilocorini)
Exochomus cubensis Dimmock (Chilocorini)
Brumoides suturalis (Fabricius) (Chilocorini)

COCCINELLINAE
Coccinella trifasciata Linnaeus (Coccinellini)
Coccinella transversoguttata Faldermann (Coccinellini)
Coccinella novemnotata Herbst (Coccinellini)
Coccinella septempunctata Linnaeus (Coccinellini)
Coccinella monticola Mulsant (Coccinellini)
Adalia bipunctata (Linnaeus) (Coccinellini)
Cycloneda munda (Say) (Coccinellini)
Cycloneda sanguinea (Linnaeus) (Coccinellini)
Mulsantina picta (Randall) (Coccinellini)
Mulsantina hudsonica (Casey) (Coccinellini)
Olla abdominalis Say (Coccinellini)
Neoharmonia venusta (Melsheimer) (Coccinellini)
Propylaea quatuordecimpunctata (Linnaeus) (Coccinellini)
Anatis ocellata Linnaeus (Coccinellini)
Anatis quindecimpunctata Olivier (Coccinellini)
Anisocalvia quatuordecimguttata Linnaeus (Coccinellini)
Synonycha grandis (Thunberg) (Coccinellini)
Hippodamia parenthesis (Say) (Coccinellini)
Hippodamia tredecimpunctata (Linnaeus) (Coccinellini)
Hippodamia convergens Guerin (Coccinellini)
Hippodamia glacialis (Fabricius) (Coccinellini)
Hippodamia quinquesignata (Kirby) (Coccinellini)
Coleomegilla maculata DeGeer (Coccinellini)
Naemia seriata (Melsheimer) (Coccinellini)
Eriopis connexa ((Germar) (Coccinellini)
Psyllobora vigintimaculata Say (Psylloborini)

Pupae were examined with a stereo-microscope with magnification from 6X to 200X. Pupae were submerged in a small dish containing alcohol with sandy subtrate on which the specimens can be oriented easily. The background may be adjusted from light to dark by using various colored sands which helps to reveal inconspicuous characters such as setae. Illumination was provided by an adjustable light source which could be varied from very dim to very bright. In addition, different colored light filters were helpful, a deep blue filter being most useful. The dimensions of the pupae were measured with an ocular micrometer.

COMPARATIVE MORPHOLOGY

General

Pupae of Coccinellidae are exarate with all appendages free. The larval exuvium usually folds back and covers the anal end of the pupa (Figs. 1, 244). However, in CHILOCORINI and NOVIINI the pupa is enclosed in an almost intact last larval exuvium, broken only by a dorsolongitudinal slit through which the pupa can be seen (Fig. 239); and in HYPERASPINI (*Hyperaspis* and *Thalassa montezumae*) the last larval exuvium entirely covers the ventral surface of the body including the head.

The size may range from minute (1mm in length) as in *Microweisea ovalis*, to moderately large (12mm or more in length) as in *Anatis quindecimpunctata*, *Anatis ocellata* and *Synonycha grandis*. The body is usually slightly elongate oval. However, in *Coccinella, Olla,* and *Axion* the body is very rounded-oval and strongly convex dorsally; and in *Hippodamia, Coleomegilla, Paranaemia,* and *Eriopis*, the body is elongate-oval.

The maculation pattern also varies a great deal among coccinellid pupae. However, it is possible to distinguish two main groups. The first group consists of all members of COCCINELLINAE (Coccinellini and Psylloborini) in which the dorsal surface of the body including the elytra is usually distinctly marked with dark spots (brown, dark brown or black) or with pale spots (yellowish). The second group consists of the remaining species of the family in which the body is usually entirely pale, yellowish or brownish or brown, with spots rarely present.

Setae and external texture of the body wall

All members of subfamily COCCINELLINAE have setae that are very short and fine, with setal length never exceeding the thickness of the lateral margin of the pronotum. The remaining members of the family are usually very densely and coarsely setiferous, with the setal length greatly exceeding the thickness of the lateral margin of the pronotum.

Setae may be very coarse and bristle-like (macrosetae) (Fig. 108) as in most SCYMNINAE, CHILOCORINAE (*Chilocorus*) and EPILACHNINAE. Macrosetae may be born on a flat cuticular ring (Figs. 108, 206, 241) as in *Epilachna, Hyperaspis, Cryptolaemus* and *Thalassa,* or on a tubercle (Fig. 22, 110) as in *Stethorus.*

Microsetae, which are distinguished from macrosetae by being either more slender or very short and fine, are present on most species. In the COCCINELLINAE microsetae are usually borne on a slightly elevated cuticular ring with the tip either slightly enlarged and truncated (Fig. 7, 8) as in *Coccinella, Adalia, Hippodamia* and *Psyllobora*, or pointed as in *Cycloneda, Anatis, Mulsantina,* and *Synonycha,* or borne on a small tubercle or chalaza with the distal end strongly curved as in *Propylaea* and *Anisocalvia* (Figs. 172, 177). Very long and fine hair-like setae have only been found on *Orcus chalybeus* (Fig. 29).

Ornamentation of the body surface (excluding "wrinkles") varies from being entirely smooth as in all members of the STICHOLOTINAE, EPILACHNINAE, and SCYMNINAE, and some members of the COCCINELLINI (*Anatis* and *Synonycha*), to being slightly rough with the surface clothed with very slightly rounded bumps (Fig. 7) as in *Cycloneda* and *Mulsantina*. The body surface may also be covered with very

fine sharp spines as on the elytral surface of *Coccinella,* and *Hippodamia,* and on the hind wing apex of *Coccinella* and *Adalia* (Figs. 8, 179-184). Spines may become more conspicuous and larger as on *Axion* and *Exochomus* (Fig. 25).

Head

The head capsule of coccinellid pupae is of the opisthognathous type in which the mouth parts are deflected in a posteroventral position. Epicranial sutures are nearly obsolete or wanting but may be discerned as deep depressions in *Coccinella* and *Hippodamia.* The frontal sutures are distinctly visible in *Stethorus* and *Rodolia* (Figs. 17-22, 50, 51). The cranial capsule is often well and homogeneously sclerotized except in STETHORINI where the frontal area remains membranous and usually protuberant (Figs. 20, 22).

The eyes do not vary much among coccinellid pupae. The inner lateral portion of the ocular suture is well defined, but the eye facets are not well defined.

The antennae, in contrast, vary a great deal from one group to another. In most cases, the antenna is long and may exceed the distance between the eye and the widest lateral margin of the pronotum as in *Propylaea quatuordecimpunctata*, or *Psyllobora vigintimaculata* (Figs. 44, 46). In others, it only extends to the widest lateral margin of the pronotum (Figs. 9, 10, 32) as in *Coccinella, Hippodamia, Anatis, Cycloneda, Adalia, Microweisea* and *Epilachna.* In a few cases the antenna is shorter, extending less than half the distance between the eye and the widest lateral margin of the pronotum (Figs. 12, 15, 19) as in *Synonycha grandis, Hyperaspis, Zagloba ornata* and all members of the CHILOCORINI. The scape, flagellum and club of the antenna are distinct in most cases, but segmentation is poorly developed.

The scape may be enlarged and expanded caudally with the anterior surface flattened as in *Coleomegilla maculata, Naemia seriata,* or strongly convex as in *Coccinella, Hippodamia* and *Olla.* Only *Cryptolaemus montrouzieri* (SCYMNINI) and *Epilachna sp.* (EPILACHNINI) have a scape which is setiferous on the anterior surface (Figs. 10, 31, 59).

The flagellum is usually slender, slightly elbowed as in *Coccinella, Hippodamia,* and *Anatis*, or C-shaped as in *Psyllobora* and *Propylaea.* The proximal end of the flagellum is greatly enlarged and somewhat "bisegmented" in *Hyperaspis, Scymnus* nad *Cryptolaemus*, but is normal in all other species of the family. The distal end of the antenna is usually recognizable as a club which is often broadly enlarged and usually has four rings of well-developed papillae (Figs. 52, 53). The club may be said to be "distinct" when the diameter is much greater than that of the flagellum (Figs. 52, 53) or "indistinct" when the diameter of the club and the flagellum are subequal (Figs. 55-57). In the latter case, the "club" can be recognized by the presence of papillae as in *Anatis, Synonycha* and *Propylaea,* but in *Zagloba, Hyperaspis* and the CHILOCORINI the flagellum is short and tapered distally, with no papillae present (Figs. 61-63).

The Clypeus and labrum are usually united into a clypeolabrum in which the clypeolabral suture may be seen as a transverse arched depression. The clypeolabrum is usually large, subquadrate, subhexagonal or trapezoidal, and usually as long as wide (Figs. 9, 14, 32) except in *Rhizobius ventralis, Rodolia cardinalis* nad *Psyllobora vigintimaculata* where it is twice as wide as long (Figs. 11, 46, 50). The apical margin

may be truncated (Fig. 46) as in *Psyllobora vigintimaculata,* slightly convex as in *Anatis* and *Synonycha* (Fig. 32), slightly to deeply concave as in *Coccinella, Cycloneda, Olla* and *Adalia,* or deeply notched as in *Eriopis connexa,* and most *Hippodamia* (Figs. 41, 49). The clypeus is greatly dilated laterally and conceals the antennal bases only in the CHILOCORINI (Figs. 23-29).

The mandible is usually bifid and pointed at the tips as in COCCINELLINAE, STICHOLOTINAE and SCYMNINAE, (the posterior tip of the mandible of the latter is greatly reduced in size). In *Epilachna* the mandible is well developed for the phytophagous habit, with the chewing tips angulated, truncated or pointed as seen from the apex, and the mesal area broadly concave as in Figs. 72-78. In members of the tribe CHILOCORINI, in contrast, the mandible is simple at the tip (Figs. 64-67). Throughout the family the mola is usually rather well developed.

The maxilla is bulbous in appearance. The palpus is large, trapezoidal, or lanceolate, and is glabrous except in *Zagloba ornata* and *Cryptolaemus montrouzieri* where it is monosetose at the apex (Figs. 84, 85), and in EPILACHNINAE where the palpus is densely setiferous (Figs. 9, 10, 83).

The galea is also bulbous, as viewed from the top, appearing subquadrate or subpentagonal with a small hook-shaped lobe at the inner anterior angle caused by the impression of the mandibular tip (Figs. 79-82). The galea is small, but greatly enlarged in *Psyllobora* and *Epilachna* where the greatest width of the galea is subequal to the base of the maxillary palpus (Figs. 83, 92). The galeal surface is smooth, but may be armed with compact and sharp spinules in *Anatis, Mulsantina, Cycloneda,* and *Adalia* (Figs. 79-82).

The lacinia is located beneath the galea, small and not as well defined.

The labium is bulbous with a distinct mentum. The labial palpi are large, stout, and short, with the tip rounded except in *Chilocorus* and *Epilachna.* In *Delphastus* the labial palpi appear more slender.

The hypopharynx is enlarged anteriorly as seen from the apex and is appressed laterally by the large and bulbous maxillary galeae (Figs. 95, 100). The labium is entirely glabrous, except in *Epilachna* where the labial palpi are monosetose at the tip, bisetose at the lateral margins of the base, and monosetose at the base of the ligula (Figs. 99, 100). In *Hyperaspis* (Figs. 96, 97) the anterior face of the ligula is densely setiferous.

The thorax

The pronotum is large and immarginate as in *Coccinella* and STICHOLOTINAE, or strongly marginate apically as in most members of the COCCINELLINAE except *Coccinella, Adalia, Hippodamia* and *Eriopis.* In CHILOCORINI and *Thalassa montezumae* (HYPERASPINI) the pronotum is greatly expanded laterally (particularly along the posterior margin), pushing the lateral margin of the pronotum downward and forward, and in some cases (as in *Axion*) the lateral side may descend considerably beyond the lower margin of the eye (Fig. 24), giving the pronotum as seen from the top a crescent shape (Figs. 106, 107). In the COCCINELLINAE, the pronotum is usually subquadrate with the anterior margin very slightly concave or almost straight. In contrast, the remaining species in all groups (including *Epilachna*) usually have the anterior margin of the pronotum deeply concave (Fig. 108). The

posterior margin of the *pronotum* is often rounded and convex (Figs. 105, 112, 115) except in *Stethorus* where it is broadly tuberculated (Fig. 110), and in *Scymnus* where it is expanded caudally into a rounded lobe (Fig. 109). The lateral margins of the pronotum are straight or slightly concave in all cases, with the edge often rounded except in *Hippodamia* where it is greatly expanded into a sharp knife-like edge (Fig. 133). A medio-longitudinal pale line is usually seen in COCCINELLINAE (Figs. 111-140).

The mesonotum is usually trapezoidal in shape, with the anterior margin much longer than the posterior one, and often spotted in the COCCINELLINAE (Fig. 1). The scutellar area may be recognized as an elevated area at mid-base.

The metanotum is more or less trapezoidal with the posterior margin usually straight except in HYPERASPINI where the margin is slightly sinuate (Fig. 236). The metanotum is also often spotted in COCCINELLINAE.

The elytra are elongate oval or rectangular, bending ventrally to cover most of the hind legs and abdominal sterna. The elytral area of coccinellid pupae may be divided as in Figs. 5 and 6, in which the apex possesses the most significant characters. In most cases the lateral angle is obtusely rounded and almost continuous with the lateral margin (Fig. 5), but especially in *Hippodamia* (Figs. 6, 164-170), the lateral angle sharply expands anteriorly into a well defined rounded lobe. The epipleuron is usually wide and slightly concave. In COCCINELLINAE, the lateral margin of the elytron is strongly marginate (Fig. 161) but in the rest of the family it is immarginate (Fig. 162). The elytral surface is smooth except in some members of the COCCINELLINI where the surface is covered with microscopic rounded bumps (micronodulated, Fig. 7), and in the CHILOCORINAE (especially in *Axion, Exochomus* and *Brumoides*) where the elytral surface is obviously spinose (Fig. 25).

The hind wing is usually semi-sclerotized or membranous, bulbous and tapered apically. The surface is always smooth and glabrous except in *Coccinella* and *Adalia* where the apex is covered with very fine and sharp spines, (microspinulated, Figs. 179-184), and in the STICHOLOTINAE and COCCIDULINAE where the apex of hind wing is finely setiferous (Figs. 232-234, 243).

The structure of the legs of coccinellid pupae is homogeneous throughout the family. The articulations are poorly developed, with the femur and tibia apparently "fused" together along their margins. The tarsus is weakly segmented, but the terminal segment is rather clearly defined by being more slender and cylindrical. Claws are often undefined and obtuse except in *Psyllobora vigintimaculata* where the claws are more distinct and pointed. In *Exochomus* the terminal segment is more slender, with the diameter about one-fourth the dorsal length of the tarsus (similar to Fig. 104). Only in *Stethorus* and *Scymnus* are the coxae more widely separated posteriorly, with the distance between the procoxae being one-half as wide as that between the metacoxae (Fig. 238).

The abdomen

Abdominal terga: In general, coccinellid pupae may be placed in two groups, one group with broad intersegmental conjunctivae clearly visible between segments 4 and 5, 5 and 6, and 6 and 7 (Figs. 1, 244, 245). These intersegmental conjunctivae appear to be as strongly sclerotized as the terga with the exception of a transverse line which

allows the conjunctiva to fold upon itself. This morphological adaptation is exclusively in the COCCINELLINAE and allows the abdomen to move more freely. The conjunctivae are finely setiferous except in *Hippodamia* where they are glabrous.

The second group consists of the remaining species of the family in which all terga are closely opposed to one another without exposed conjunctivae (Figs. 240-243), resulting in greatly reduced flexibility of the abdomen.

As mentioned above, the dorsum of the abdomen of COCCINELLINAE is distinctly maculate, while the remaining species of the family are usually immaculate and pale yellowish or brownish.

Urogomphi: Abdominal tergum 9 is usually modified into one pair of lateral cerci-like processes or urogomphi which serve as grasping appendages to permit the pupa to attach to the substrate within the last larval exuvium. Tergum 9 also bears a dorsal median lobe or pygidium which is glabrous in COCCINELLINAE and STETHORINI, and finely setiferous in CHILOCORINI, SCYMNINI, HYPERASPINI, COCCIDULINI, SCYMNILLINI, SERANGIINI, STICHOLOTINI, and EPILACHNINI. The shape of the urogomphi is strikingly different from one group to other, except for the STICHOLOTINAE which have no urogomphi (Figs. 195-198). The urogomphi may be long, slender and subcylindrical, with the tip simple and obtusely rounded as in *Epilachna* and *Scymnus* (Figs. 199, 201). In *Stethorus,* the urogomphal tip is slightly flared into a flat subcircular distal disk (Figs. 210, 211). In *Lindorus lophantae* the tip is tapered to a point (Fig. 202). In another case restricted to the COCCINELLINAE, the urogomphi appear less slender, with the distal end twisted and folded ventroanterad into a bilobed distal disk (Figs. 218-229) as seen ventrally. The inner lateral side of the urogomphus is usually straight except in *Anatis, Synonycha, Anisocalvia* and *Neoharmonia* where a spine-like process (Fig. 223) is present. In HYPERASPINI the urogomphi are quite short, with the distal disk very well developed, sclerotized and double parenthesis-shaped as seen ventrally (Figs. 207,208). In *Cryptolaemus montrouzieri,* the urogomphi branch at the distal one-third into a large sausage-like process (Figs. 205, 206), which is quite different from *Scymnus* where the urogomphi are unbranched. The urogomphi of CHILOCORINI are very characteristic, with either single or double branches and with the distal end greatly enlarged into rounded mushroom-shaped tips (Figs. 215-217).

Abdominal pleura: The structure of the abdominal pleura is very homogeneous in coccinellid pupae. They often are greatly expanded laterally into subquadrate or rhomboidal plates, with the lateral margin usually simple, straight, or slightly convex (Figs. 171, 172, 174) except in *Eriopis connexa*, where the lateral margin of pleura 3, 4, and 5 is slightly angulate (Fig. 175), and in *Anisocalvia, Anatis* and *Synonycha* where the posteriolateral angle projects laterocaudad into a conical or long, cylindrical spine-like process (Figs. 176-178). In *Neoharmonia venusta* the posteriolateral angle of the pleura expands slightly caudally on segments 3, 4 and 5 (Fig. 171). This is intermediate between the "*Anatis* type" and the undifferentiated type. Pleura 1 and 2 are always hidden under the elytra and pleuron 9 is often fused with the base of the urogomphus. In HYPERASPINI, unlike all other groups, the abdominal pleura strongly curve ventrally, and thus are invisible from above (Fig. 236).

Abdominal sterna: The structure of the abdominal sterna is also very homogeneous among coccinellid pupae. There are usually nine, however, the first two are greatly reduced in size and hidden beneath the hind coxae except in a few cases where they are visible medially as in *Anatis* and *Synonycha*. In the ♂, the ninth sternum is entirely flat and small, whereas in the ♀ it is bipartite (Figs. 215, 218), and mammillate with the tip of the mammilla usually more sclerotized than the base. In SERANGIINI and STICHOLOTINI the tip is very large (Figs. 195-198).

The Spiracles

The prothoracic spiracles are elongate oval in most cases, or rounded as in *Adalia bipunctata* and *Eriopis connexa*.

The abdominal spiracles are located on the anterolateral angle of the abdominal tergum and usually differ from group to group, except for members of tribe HYPERASPINI, in which the spiracles are wanting (Fig. 236). The different types of spiracles can be distinguished as follows:

— In EPILACHNINI all abdominal spiracles are slightly and subequally pedunculate, with the peduncles semisclerotized or membranous (Fig. 235). This type of spiracle is also present in the COCCIDULINI and *Chilocorus*; however, the peduncle progressively decreases in length as the spiracles approach the posterior end of the abdomen (Figs. 234, 242).

— In CHILOCORINI and STETHORINI, only the first abdominal spiracles are pedunculate, with the peduncle very long, conical and strongly sclerotized in CHILOCORINI (Figs. 185-189, 240, 242), or very slender, usually cylindrical, and semisclerotized or membranous in STETHORINI (Figs. 190-192). The remaining abdominal spiracles of these two tribes are without peduncles (Fig. 240).

— Also, in the CHILOCORINI, (*Axion, Exochomus, Brumoides*), in addition to the peduculate spiracles, one pair of pit-like gland openings is present between the anterior margin of the first abdominal tergum and the posterior margin of the metanotum (Figs. 187, 239, 240). These are absent in *Chilocorus* and *Orcus*.

— Finally, the most common type of spiracle is observed in SCYMNINI, SCYMNILLINI, SERANGIINI, STICHOLOTINI, COCCINELLINI and PSYLLOBORINI where the spiracular peduncle is wanting, the opening is usually elongate oval or circular,and usually well sclerotized (Figs. 1, 244, 245). The pair of spiracles on the first abdominal segment is much larger than the rest, and is mostly hidden beneath the elytron (Figs. 1, 244, 245).

KEY TO SUBFAMILIES AND TRIBES OF THE AVAILABLE PUPAE OF COCCINELLIDAE

1 Abdomen flexible with intersegmental conjunctivae of abdominal 3 to 6 exposed (Figs. 244, 245); body finely setiferous, setae shorter than the thickness of the lateral margin of the pronotum; dorsal surface distinctly maculate (Figs. 1, 244, 245), COCCINELLINAE 2

1' Abdomen compact, without intersegmental conjunctivae exposed (Figs. 240-243); body coarsely setiferous with various types of setae, the longest setae considerably longer than the thickness of the lateral margin of the pronotum (Figs. 9-22); dorsal surface usually immaculate 3

2(1) Clypeolabrum usually as long as wide (Figs. 32-37); galea small, with the greatest width one-half as wide as the base of the maxillary palpus (Figs. 90, 91); size medium to large, over 5 mm in length .....COCCINELLINI

2' Clypeolabrum much wider than long (Fig. 46); galea greatly enlarged, with the greatest width as wide as the base of the maxillary palpus (Fig. 92); size small, less than 5mm in length .....PSYLLOBORINI

3(1') Mandibles greatly enlarged with chewing tip broadly concave mesally (Figs. 72-78); maxillary palpi densely setiferous (Figs. 9, 10, 83); abdominal spiracles subequally pedunculate (Fig. 235) EPILACHNINAE.....EPILACHNINI

3' Mandibles not enlarged, tip pointed, simple or bifid, maxillary palpi glabrous or monosetose (Figs. 12, 31, 84, 85); abdominal spiracles variable but never subequally pedunculate 4

4(3') Clypeus broadly expanded laterally, concealing antennal bases (Figs. 23-29); mandible simple at tip (Figs. 64-67); pupa usually enclosed in the last larval exuvium; and visible through a dorso-longitudinal slit (Fig. 239), CHILOCORINAE.....CHILOCORINI

4' Clypeus normal, antennal bases visible (Figs. 11-22); mandibles usually bifid at tip (Figs. 68-71); pupa usually free from last larval exuvia (Fig. 234) 5

5(4') Hind wing apex finely setiferous dorsally; setae fine and thin 6

5' Hind wing apex glabrous; setae coarse or bristle-like, SCYMNINAE 10

6(5) Urogomphi wanting (Figs. 195-198); clypeolabrum as long as or longer than wide (Figs. 13, 14), STICHOLOTINAE 7

6' Urogomphi well developed (Figs. 11, 12, 50); clypeolabrum wider than long, COCCIDULINAE.....8

7(6) Pronotum with a dorsolongitudinal depression (Fig. 13); abdominal pleura glabrous; posterior margin of pygidium deeply concave (Figs. 195-196), *Delphastus pusillus* (Leconte) .....SERANGIINI

7' Pronotum without such a dorsolongitudinal depression; abdominal pleura setiferous; posterior margin of pygidium subparallel with anterior margin (Figs. 197-198), *Microweisea ovalis* (Leconte) .....STICHOLOTINI

8(6') Abdominal pleura 3 to 5 greatly expanded laterally with lateral margin strongly convex (Fig. 234); dorsum of abdominal tergum non-tuberculate (Fig. 234) 9

8' Abdominal pleura 3 to 5 not expanded laterally, subquadrate (Fig. 243); dorsum of abdominal terga each with one transverse pair of tubercles (Fig. 243), *Rodolia cardinalis* Mulsant .....NOVIINI

9(8) Antennae tapered distally (Figs. 12, 61) and short, extending to a point about midway between the eye and the widest lateral margin of the pronotum (Fig. 12); first four abdominal spiracles normal; maxillary palpus monosetose (Figs. 12, 84), *Zagloba ornata* (Horn) .....SCYMNILLINI

9' Antennae enlarged distally into a distinct club with well developed papillae (Fig. 11), and extending to the widest lateral margin of the pronotum (Fig. 11); first four abdominal spiracles slightly pedunculate (Fig. 234); maxillary palpus glabrous . . . .COCCIDULINI

10(5') Head with frontal area membranous and usually protuberant (Figs. 20, 22); first abdominal spiracles pedunculate (Figs. 190-192, 237); femora glabrous .....STETHORINI

10' Head with frontal area as sclerotized as the other areas; first abdominal spiracles not pedunculate or obsolete; femora setiferous 11

11(10') Abdominal pleura visible from above, abdominal spiracles present; antennal club distinct (Figs. 31, 58, 59) .....SCYMNINI

11' Abdominal pleura not visible from above (Fig. 236); abdominal spiracles absent; antennal club indistinct (Figs. 15, 16) .....HYPERASPINI

SUBFAMILY STICHOLOTINAE

Diagnosis

This is the only known group of pupae of Coccinellidae which lack urogomphi. However, they appear to have a strong affinity to Coccidulinae by having the hind wing apex finely setiferous dorsally on the lateral angle (Figs. 232-234). Moreover, the simple mandibular tip allies the Sticholotinae with members of Chilocorinae (Chilocorini) which have also retained this primitive type of mandible.

TRIBE SERANGIINI

Genus DELPHASTUS Casey

Specimens examined

The study was based on three pupae of *Delphastus pusillus* from the U.S. National Museum, collected in Havana, Cuba, 29 September 1928 by Brinner.

Diagnosis

Serangiini and Sticholotini are the only two tribes for which pupae were available in the subfamily Sticholotinae. They are usually minute in size (about 1mm to 1.50mm in length). Serangiini can be recognized by the dorsolongitudinal depressed line on the pronotum (Figs. 13, 233), the abdominal pleura and terga 3 to 5 are glabrous, and the posterior margin of the pygidium is deeply notched. In the Sticholotini the dorsum of the pronotum is convex, all abdominal terga and pleura are uniformly setiferous, and the anterior and posterior margins of the pygidium are subparallel.

Delphastus pusillus (Leconte)
(Figs. 13, 60, 87, 101, 195, 196, 233)

Description

Length: 1.5mm; width: 1mm. Body small, rounded oval, yellowish, immaculate, and densely setiferous dorsally. Head pale, setiferous. Antennae long with club greatly enlarged and slightly compressed dorsoventrally, with 3 rings of poorly developed papillae; antennal scape and the last 2 "segments" of flagellum somewhat papillated and enlarged (Fig. 13). Clypeolabrum narrow, with lateral sides subparallel, greatly narrowed apically, and apical margin slightly concave (Fig. 13). Mandibles simple at tip. Maxillary palpi long, slender, somewhat cylindrical (about 3 times or more longer than wide), and slightly curved inward at base (Fig. 13).

Pronotum elongate oval as seen from above, with a wide dorsolongitudinal depression line (Figs. 13, 233). Metanotum large and as long as the first two abdominal terga combined (Fig. 242). Elytra pale yellowish, immaculate, and densely setiferous. Hind wings semi-membranous with dorsal surface of lateral apical angle densely setiferous. Legs short and rather robust.

Abdominal terga yellowish, immaculate, closed tightly together, with the first two terga and terga 6 to 9 setiferous, whereas terga 3 to 5 are very finely setiferous or apparently glabrous. Pygidium small with posterior margin deeply notched. Urogomphi wanting (Figs. 195, 196). Abdominal pleura subquadrate, usually in a verticle position and glabrous. Abdominal sterum 9 of the ♀ characteristically modified with a pair of greatly elongate and conical "gonopods" (Fig. 196). In the ♂, the sternum remains flat and small (Fig. 195).

TRIBE STICHOLOTINI

Genus MICROWEISEA Cockerell

Specimens examined

The study was based on 2 pupae of *Microweisea ovalis* from the U.S. National Museum, collected in New Orleans, Louisiana, on 13 July 1923.

Diagnosis

See *Delphastus pusillus* for the separation of these two tribes.

Microweisea ovalis (Leconte)
(Figs. 14, 197, 198, 232)

Description

Length: 1.25mm; width: 0.75mm. Body pale brownish, immaculate and apparently setiferous. Very similar to *Delphastus pusillus.*

Head longer than wide. Antennae long, extending to the widest lateral margin of the pronotum; club enlarged and with well developed papillae; flagellum cylindrical and slender. Clypeolabrum subtriangular, with apex very narrow and truncate (Fig. 14). Mandibles simple at tip. Maxillary palpi slender, very long and cylindrical (Fig. 14).

Pronotum nonmarginate and densely setiferous. Elytron brownish, and conspicuously and densely setiferous. Dorsal side of abdomen uniformly and densely setiferous. Pygidium small and subrectangular. Abdominal pleura subquadrate, with the 3rd and 4th pleura conspicuously and densely setiferous. Venter of the abdomen entirely pale and sparsely setiferous. In the ♀, the "gonopods" (9th abdominal sternum) are conical and greatly elongate (Fig. 198). Sternum 9 of the ♂ is short and inconspicuous (Fig. 197).

SUBFAMILY COCCIDULINAE

Diagnosis

Coccidulinae are separated from Sticholotinae by the presence of one pair of prominent urogomphi and by abdominal pleura 3 to 6 being greatly expanded

laterally, giving the lateral margin of the pleuron a strongly convex appearance (Fig. 234). These two subfamilies in turn are distinguished from the remaining groups of Coccinellidae by the characteristically setiferous hind wing apex (Figs. 232-234).

TRIBE COCCIDULINI

Diagnosis

The Coccidulini is the only group of pupae with at least the first four pairs of abdominal spiracles slightly pedunculate (Fig. 234). This character is also observed in Epilachnini, but in the Epilachnini all abdominal spiracles except those on segment 9 are slightly and subequally peduculate. The above character separates Coccidulini from Scymnillini whose abdominal spiracles are circular or nearly so (= not pedunculate). Furthermore, the long antennae with a distinct papillated club, and the slender urogomphi with the tip unevenly pointed, are very characteristic of this tribe. In the Scymnillini, the antennae appear short with an indistinct club, papillae are entirely absent, and the urogomphi have enlarged tips (Figs. 12, 203, 204).

Key to Genera of the Available Pupae of Coccidulini

1 Body very densely setiferous, dorsum nearly clothed with short, thin, semi-erect setae whose tips strongly curve back to the body surface; macrosetae (long setae) sparsely distributed; pygidium shorter than abdominal tergum 7 . . . . . *Rhizobius ventralis* (Erichson)

1' Body less densely setiferous, setae erect with tip not curved back to body surface; pygidium as long as abdominal tergum 7 . . . . . *Lindorus lophantae* Blaisdell

Genus LINDORUS Casey

Lindorus lophantae (Blaisdell)
(Figs. 11, 202, 234)

Specimens examined

The study was based on four pupae of *Lindorus lophantae* from the U.S. National Museum, reared by the Bermuda Department of Agriculture, 13 June 1952.

Diagnosis

This species, in general, is very easily separated from *Delphastus pusillus* and *Microweisea ovalis* by possessing very prominent and slender urogomphi (Fig. 202), and by the clypeolabrum being much wider than long (Fig. 11). In *Delphastus* and *Microweisea* the urogomphi are wanting, and the clypeolabrum is longer than wide (Figs. 13, 14, 195-198).

Description

Length: 2mm; width: 1mm. Body elongate oval, densely setiferous, pale and immaculate. Head wide, clypeolabrum wider than long with apex slightly convex (Fig. 13). Antennae long, extending to the widest lateral margin of the pronotum; club distinct and large, elongate cylindrical, with 4 rings of well developed papillae. Mandibles unequally bifid at tip.

Pronotum pale or brownish, densely setiferous both dorsally and ventrally, and immarginate with the anterior margin concave. Posterior margin of metanotum slightly sinuate (Fig. 234). Elytron pale and setiferous (except brownish in one specimen); lateral margin immarginate. Hind wings membranous, gradually tapering toward apex where dorsal surface is setiferous (Fig. 234). Legs short and robust with femora densely setiferous.

Abdominal terga subequal in length, each with 2 pairs of conspicuous groups of setae located at spiracular and dorsal areas. Spiracular group consisting of four conspicuous setae, whereas dorsal group consists of three (Fig. 234). Pygidium large, trapezoidal, setiferous and as long as the 7th abdominal tergum. Urogomphi strongly sclerotized, extremely slender and cylindrical, tapering, and pointed apically (Fig. 202). First 4 abdominal spiracles slightly pedunculate (Fig. 234). Abdominal pleura 1 and 2 hidden under the elytron, pleura 3 to 6 greatly expanded laterally, with lateral margin strongly convex and conspicuously setiferous (Fig. 234). Abdominal sterna pale, densely setiferous along posteriomarginal areas. Sternum 8 small, about one-half as long as sternum 7.

Genus RHIZOBIUS Stephens

Rhizobius ventralis (Erichson)

Specimens examined

The study was based on two pupae of *Rhizobius ventralis* from the U.S. National Museum collected in California on 15 June 1896.

Description and diagnosis

Very similar to *Lindorus lophantae* in many respects except for the following characters:

Length: 3.5-4mm; width: 1.5-1.8mm. Body more densely setiferous, with setae semi-erect and with the distal ends strongly curved back to the body surface. However, because of the poor condition of the specimens, it is very difficult to distinguish this species from *Lindorus lophantae* in terms of chaetotaxy. Pygidium much shorter than abdominal tergum 7.

TRIBE SCYMNILLINI

Genus ZAGLOBA Casey

Specimens examined

The study was based on a single pupa of *Zagloba ornata* from the U.S. National Museum reared by the Bermuda Department of Agriculture from California stock, 13 June 1952.

Diagnosis

See diagnosis of Coccidulini for the separation of these two tribes.

Zagloba ornata (Horn)
(Figs. 12, 61, 84, 102, 203, 204)

Description

Length: 2.5mm; width: 1.5mm. Body pale brownish, very densely setiferous, similar to *Lindorus lophantae* except for the following characters:

Head pale yellowish, slightly longer than wide (Fig. 12). Antennae short, extending to about one-fourth the distance between the eye and the widest lateral side of the pronotum; scape and the first two "segments" of flagellum greatly enlarged (much larger than distal portion which is somewhat cylindrical and rounded at tip) (Fig. 12, 61). Clypeolabrum subquadrate and sparsely setiferous, apical margin slightly concave (Fig. 12). Mandible unequally bifid at tip. Maxillary palpi long and cylindrical, with the apex rounded and monosetose (Figs. 12, 84).

Pronotum and mesonotum slightly darker (brownish) than any other areas.

Abdomen appearing more densely setiferous than *Lindorus*. Abdominal spiracles subcircular and normal (without peduncle). Abdominal pleura 3, 4, and 5 greatly expanded laterally, rounded and densely setiferous (Fig. 234). Urogomphi short (as long as pygidium), with distal end slightly enlarged and curved ventrally (Figs. 203, 204).

TRIBE NOVIINI

Genus RODOLIA Mulsant

Specimens examined

The study was based on 8 pupae of *Rodolia cardinalis* collected in Gainesville, Florida, on 14 July 1972 by R. E. Waites. Two pupae are deposited in the Entomology Museum of Michigan State University, the remainder in the Department of Entomology and Nematology, University of Florida.

Diagnosis

Noviini can be separated from Coccidulini (=Rhizobiini) and Scymnillini by the subvertical position of the abdominal subquadrate pleura whose lateral margins are usually straight; and by the two-branched uorgomphi. In Coccidulini and Scymnillini, the abdominal pleura are usually greatly expanded laterally, are horizontal in position with strongly convex lateral margins. The urogomphal apices are pointed or slightly enlarged. The Noviini are placed in the subfamily Coccidulinae with the Coccidulini and Scymnillini because they possess the distinctive finely setiferous hind wing apex.

Rodolia cardinalis Mulsant
(Figs. 50, 51, 230, 231, 243)

Description

Length: 4-4.5mm; width: 2.5-3mm. Body elongate oval. The abdomen is subrounded in cross section, retaining much of the larval aspect and is twice as long as the thorax. Dorsum yellowish to brownish, with undefined brown spots on mid-dorsal area of abdominal terga where a slight depression is located. In general, the body is densely setiferous with the setae on the pronotum and the dorsum of the abdomen appearing coarser than on the other areas of the body surface. The body is almost enclosed in the last larval exuvia.

Head broad, as wide as long. Antennae short, extending slightly beyond the outer lateral margin of the eye, without papillae. Club indistinct from the flagellum. Scape enlarged and rounded (Fig. 50). Clypeolabrum large, much wider than long, with the apical margin slightly concave (Fig. 50). Mandibles unequally bifid at the apex, with the posterior tip greatly reduced in size. Maxillary palpi with the apex enlarged.

Pronotum immarginate, mostly pale except for one pair of pooly defined brownish discal spots. Surface of the pronotum densely setiferous, and setae adjacent to discal spots strongly pigmented. Meso- and metanotum brown except scutellar area on mesonotum pale yellowish. Elytron elongate oval, pale whitish except for brownish basal and scutellar areas. Lateral margin immarginate. Epipleura sparsely setiferous and slightly concave. Hind wing apex finely setiferous dorsally, especially along lateral margin. Legs short and robust with femora densely and finely setiferous.

Abdominal terga yellowish to brownish. Each tergum usually with a dorsally joined pair of depressions where the coloration is darker than other areas, and one pair of transverse-banded tubercles running the tergal width, on which setae are very dense. Tubercles much reduced in size or wanting in terga 6 to 9. Urogomphi bipartite, the outer branch with apex simple, the inner branch shorter but with apex modified into a parenthesis-shaped distal disk (Figs. 230, 231). This character indicates some relationships with Hyperaspini (SCYMNINAE) and Chilocorini (CHILOCORINAE) whose urogomphi are usually bipartite. Abdominal spiracles small, inconspicuous and normal (nonpedunculate). Abdominal pleura subquadrate and in a subvertical position. Abdominal sterna entirely pale.

SUBFAMILY EPILACHNINAE

TRIBE EPILACHNINI

Diagnosis

This is the only group of coccinellid pupae in which the chewing tip of the mandibles is distinctly and broadly concave mesally (Figs. 72-78). The maxillary palpi are densely setiferous (Figs. 9, 10, 83), and the abdominal spiracles are membranous and slightly pedunculate (Fig. 235).

Genus EPILACHNA Chevrolat

Description

Length: 7.5mm-8.00mm; width: 4.5-5mm. Body moderately large, pale yellowish, usually immaculate and densely setiferous.

Head pale, as long as wide. Antennae (Fig. 9) long, extending to the widest lateral margin of the pronotum. Club monosetose distally, and indistinct, with three or four rings of papillae (Fig. 57). Flagellum long, subquadrate in cross section and slightly elbowed or C-shaped. Clypeolabrum narrow, subtrapezoidal with the apical margin concave (Fig. 9). Mandible large, visible without removing the clypeolabrum; the chewing tip bifid as seen from the top and distinctly and broadly concave mesally (Figs. 72-78). Maxillary palpi densely setiferous (Fig. 83).

Pronotum nearly twice as wide as long, the posterior margin arcuate and the anterior margin deeply concave. Macrosetae dense but confined to the margins of the pronotum (Fig. 108). Elytron pale, immaculate, and three times as long as wide. Epipleura glabrous and wide. Hind wing pale and entirely glabrous.

Abdomen compact, usually immaculate and pale, with macrosetae somewhat sparsely distributed on dorsal surface. In contrast, the microsetae are more densely distributed over the rest of the body. Pygidium small and finely setiferous. Urogomphi slender, subcylindrical and straight at apex (Fig. 199). All abdominal spiracles distinctly pedunculate (with the peduncle usually as long as the diameter of the spiracular opening).

Key to Species of the Available Pupae of *Epilachna*

1 Anterior surface of the antennal scape setiferous (Fig. 10); both anterior and posterior mandibular tips pointed as seen from the apex (Fig. 77) ..... *Epilachna sp.*

1' Anterior surface of the antennal scape glabrous (Figs. 9, 57); anterior mandibular tip truncate as seen from the apex (Figs. 74, 78) 2

2(1') Posterior mandibular tip sharply pointed as seen from the apex (Fig. 78); one pair of distinct eye-like brown spots present on abdominal terga 3 to 5 .....
.....*Epilachna borealis* (Fabricius)

2' Posterior mandibular tip angulate or truncate as seen from the apex (Fig. 74); abdominal terga 3 to 5 immaculate
.....*Epilachna varivestis* Mulsant

Epilachna borealis (Fabricius)
(Figs. 9, 57, 75, 78)

Specimens examined

The study was based on a single pupa associated with adults, from the U.S. National Museum collected in Quincy, Florida 9 August 1944.

Diagnosis

Epilachna borealis has one pair of eye-like brownish spots per segment on abdominal terga 3 to 5 and **only** the posterior tip of the mandible is pointed as seen from the apex. In *Epilachna sp.* **both** the posterior and anterior mandibular tips are pointed, and in *Epilachna varivestis*, the posterior mandibular tip is truncate or angulate as seen from the apex. The last two species are usually entirely pale dorsally.

Description

Length: 7mm; width: 5mm. Body pale yellowish, broadly oval with macrosetae sparsely distributed on dorsal surface.

Head entirely pale yellowish. Antennae long, with flagellum C-shaped and scape distinct and glabrous. Mandible with the posterior tip pointed and the anterior tip truncate as seen from the apex (Fig. 78). Dorsum of abdomen sparsely macrosetiferous. Abdominal terga pale and immaculate except terga 1 and 2 which have a brownish posterior margin, and terga 3 to 5 which have one pair of brown eye-like spots.

Epilachna varivestis Mulsant
(Figs. 72-74, 83, 99, 100, 108, 173, 199, 200, 235)

Specimens examined

The study was based on 8 pupae from the U.S. National Museum, 1 pupa collected in Tippecanoe Co., Indiana, on 4 September 1970 by L. Matteson and 2 pupae collected in Michigan in August 1972 by D. C. Cress. The last two pupae are deposited in Entomology Museum at Michigan State University, East Lansing, Michigan.

Diagnosis

Epilachna varivestis is characterized by the truncate or angular posterior mandibular tip as seen from the apex (Fig. 74). This differs from the other two available *Epilachna* pupae (*Epilachna borealis* and *Epilachna sp.*) whose posterior mandibular tip is sharply pointed (Figs. 77, 78).

Description

Length: 6.5-7mm; width: 4.5mm. In general this species is very similar to *E. borealis* except that the body of *E. varivestis* is usually pale yellowish, and abdominal terga 3 to 5 are entirely immaculate. In addition, the number of spiracular macrosetae on abdominal segments 1-3 varied from 4 to 6, and the structure of the tip of the mandibles is strikingly different from *E. borealis* by having an angulate posterior mandibular tip as viewed from the apex (Fig. 74).

*Epilachna sp.**
(Figs. 10, 76, 77)

Specimens examined

The study was based on a single pupa from the U.S. National Museum, apparently from Brazil.

Diagnosis

This is the only known species among the available *Epilachna* pupae whose antennal scape is setiferous. In *E. varivestis* and *E. borealis* the antennal scape is entirely glabrous.

Description

Length: 7mm; width: 5mm.

Body densely macrosetiferous, immaculate and shiny brownish. Antennae long, with four rather well-developed papillae. Antennal scape bisetose or trisetose on anterior surface (Fig. 10). Clypeolabrum trapezoidal with the apical margin truncate or slightly concave and densely setiferous. Mandible unequally bifid with anterior and posterior tips pointed as seen from the apex; the posterior tip twice as large as the anterior one (Fig. 77). Maxillary palpi more densely setiferous toward outer lateral margin. Macrosetae dense and confined cephalad of abdominal tergum 5.

SUBFAMILY SCYMNINAE

TRIBE HYPERASPINI

Diagnosis

The members of this tribe possess very short antennae with the distal end tapering, pointed and lacking papillae (Fig. 62). Moreover, the Hyperaspini may additionally be separated from the Scymnini by the lack of abdominal spiracles and the short urogomphi, with the distal disk strongly sclerotized and double parenthesis-shaped as seen ventrally (Figs. 207-208).

*A new species being described by Robert Gordon, Systematic Entomology Laboratory, USDA, c/o U.S. National Museum, Washington, D.C. 20560 in a *USDA Tech. Bull.*, 1975.

Key to Genera of the Available Pupae of Hyperaspini

1 Body large, over 6mm; Pronotum greatly expanded laterally, pushing the posteriolateral margin downward beyond lower margins of the eyes (Fig. 16); Macrosetae only fringing marginal areas of the pronotum, elytra and abdomen (Fig. 236). (*Thalassa montezumae* Mulsant) . . . . . *Thalassa* Mulsant

1' Body small, under 5mm. in length; Pronotum not expanded laterally, with posteriolateral margin above the lower margins of the eyes (Fig. 15); Macrosetae more densely and uniformly distributed over entire dorsal surface of the pupa, except for a few species with discal area of the pronotum finely setiferous . . . . . *Hyperaspis* Chevrolat

Genus HYPERASPIS Chevrolat

Diagnosis

This genus is distinctly separated from *Thalassa montezumae* by its smaller size (under 5mm.), and by the densely and uniformly macrosetiferous dorsal surface of the body, especially on the elytra and the abdomen. In *Thalassa* the body appears glabrous except for the macrosetiferous marginal areas. *Thalassa* are over 5mm. in length.

Description

Length 2.5-4mm; width: 1.2-2mm. Body broadly rounded-oval, dorsum pale yellowish to brownish and densely setiferous with three types of setae. The first type of seta is the bristle-like macroseta. The dorsum of the pupa is usually densely and uniformily macrosetiferous except for a few species whose discal area of the pronotum has sparser macrosetae. The second and third types of setae are called microsetae. The second type may be as long as the first, but more slender and finer. The third type is very short, with the diameter slightly greater than the second type, and about one-tenth as long.

Head usually glabrous and pale except for the macrosetiferous vertex (Figs. 246-248). However, in *Hyperaspis binotata* and *Hyperaspis lateralis*, the entire head is densely macrosetiferous (Figs. 15, 249). Antennae short, extending to about one-third the distance between the eye and the widest lateral margin of the pronotum, with distal half subcylindrical and tapering toward apex with no papillae present (Fig. 62). Clypeolabrum gradually narrowed apically with apical margin slightly concave. Mandibles unequally bifid at tip with the posterior tip considerably reduced in size (Figs. 68, 69).

Pronotum yellowish, immarginate; macrosetae may be uniformly and densely distributed over the dorsal surface of the pronotum as in the case of *H. lateralis, H.*

binotata and *H. quadrivittata* (Fig. 263), or they may appear sparser or absent as in *H. oculaticauda* and *H. quadrioculata.* Posterior margin of metanotum slightly sinuate. Lateral margin of the elytron immarginate; epipleura wide and glabrous. Legs robust and short, with the anterior surface of pro- and mesofemora usually microsetiferous except in *H. lateralis* and *H. binotata* whose pro- and mesofemora are macro- and microsetiferous (Figs. 15, 249). All abdominal terga densely macrosetiferous. Urogomphi very short, flattened at base; distal disk strongly sclerotized, consisting of a large kidney- to crescent-shaped outer lobe and a small, elongate oval- to comma-shaped inner lobe as seen ventrally (Figs. 207, 250-256). In *H. quadrivittata*, the inner lobe is wanting and the outer lobe is greatly reduced in size and rounded (Figs. 257-258). Abdominal spiracles absent, abdominal pleura subquadrate and in a vertical position, thus invisible from above. Abdominal sterna pale and finely setiferous.

Key to Species of the Available Pupae of *Hyperaspis*

1 Head densely macrosetiferous including clypeolabrum (Fig. 249); macrosetae present on anterior surface of pro- and mesofemora 8

1' Head apparently glabrous except for the macrosetiferous vertex (Figs. 246-248); macrosetae absent on anterior surface of pro- and mesofemora 2

2(1') Pygidium macrosetiferous 3

2' Pygidium apparently glabrous 4

3(2) Macrosetae absent on discal area of the pronotum (Figs. 264-265); lateroapical margin of the elytron macrosetiferous (Fig. 259); inner lobe of urogomphus elongate oval, outer lobe large and subrectangular (Fig. 251) ..... *Hyperaspis octavia* Casey

3' Macrosetae uniformly distributed on the pronotum (Fig. 263); lateroapical margin of the elytron finely setiferous (Figs. 260-262); inner lobe of urogomphus absent, outer lobe small and subrounded or kidney-shaped (Figs. 257-258) ..... *Hyperaspis quadrivittata* Leconte

4(2') Macrosetae slender and longer than the length of abdominal tergum 1 5

4' Macrosetae stout and shorter than the length of abdominal tergum 1 7

5(4) Posterior margin of the pronotum apparently glabrous (Fig. 265) ..... *Hyperaspis quadrioculata* (Motschulsky)

5' Posterior margin of the pronotum macrosetiferous (Fig. 264) 6

6(5') Macrosetae apparently arranged in a single transverse row on the vertex (Fig. 246); macrosetae on elytron gradually becoming more slender toward the sutural, scutellar and basal areas (Fig. 260) .....*Hyperaspis oculaticauda* Casey

6' Macrosetae apparently arranged in two transverse rows on the vertex (Fig. 247); macrosetae on elytron subequal in size (Fig. 262) .....*Hyperaspis postica* Leconte

7(4') Excluding apical area, macrosetae uniformly distributed over the surface of the elytron .....*Hyperaspis cincta* Leconte

7' Excluding apical area, macrosetae absent or sparse on median area at the basal one-fifth of the elytron (Fig. 261) .....*Hyperaspis psyche* Casey

8(1) Frontal area densely macrosetiferous (Fig. 15); macrosetae covering entire surface of abdominal pleura 4 to 7 .....*Hyperaspis binotata* (Say)

8' Frontal area finely setiferous or apparently glabrous (Fig. 249); macrosetae sparse and confined to the outer lateral marginal area of abdominal pleura 4 to 7 .....*Hyperaspis lateralis* Mulsant

Hyperaspis binotata (Say)
(Figs. 15, 62, 68, 69, 86, 96, 97, 207)

Specimens examined

The study was based on 30 pupae collected on cottony maple scale in association with adults in E. Lansing, Michigan 5 July 1971 by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University.

Diagnosis

This species and *H. lateralis* represent a group of available pupae which have a densely macrosetiferous head and pro- and mesofemora. Pupae of the remaining available *Hyperaspis* species have the head (except for the macrosetiferous vertex) and all femora finely setiferous. See the diagnosis for *H. lateralis* for characters to separate it from *H. binotata.*

Description

Length: 2.5-4mm; width:1.2-2mm. Body broadly rounded-oval. Dorsum entirely brownish and uniformly and very densely macrosetiferous.

Head densely macrosetiferous including the frontal area (Fig. 15). Labium with setiferous ligula (Figs. 96, 97).

Pronotum yellowish, immarginate, densely and uniformly macrosetiferous.

All abdominal terga uniformly and densely macrosetiferous, including the pygidium. Abdominal sterna entirely pale and finely setiferous.

Hyperaspis lateralis Mulsant
(Fig. 249)

Specimens examined

The study was based on 12 pupae from K. S. Hagen's collection, collected in California in March 1971. Two pupae are deposited in the Entomology Museum at Michigan State University; the remainder are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

See diagnosis of *H. binotata* for separation of these two species from other *Hyperaspis.*

Description

Hyperaspis lateralis is very similar to *H. binotata* except that the available specimens of *lateralis* vary from 4mm to 5mm in length and 3mm to 3.5mm in width. In addition, the frontal area of *lateralis* is finely setiferous and the abdominal pleura (especially from 4 to 7) are sparsely macrosetiferous, with the macrosetae confined to the outer lateral marginal area. In *H. binotata,* the head capsule is uniformly macrosetiferous (including the frontal area), and abdominal pleura 4 to 7 are densely macrosetiferous with the macrosetae covering the entire surface of the pleuron.

Hyperaspis postica Leconte
(Figs. 247, 255, 256)

Specimens examined

The study was based on two pupae from K. S. Hagen's collection, collected in Placerville, California. One pupa is deposited in Entomology Museum at Michigan State University, the other is returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

This species represents the pupae of a group of available species including *H. quadrioculata, H. oculaticauda, H. cincta* and *H. psyche* whose pygidium is apparently glabrous. *H. postica, H. oculaticauda* and *H. quadrioculata* are separated from *H. cincta* and *H. psyche* by the slender macrosetae whose length may exceed the length of abdominal tergum 1. In *H. cincta* and *H. psyche,* the macrosetae appear stout and much shorter than the length of abdominal tergum 1. Furthermore, *H. postica* can be distinguished from *H. oculaticauda* by the double subparallel transverse row of macrosetae on the vertex, compared with only a single transverse row of

macrosetae on *H. oculaticauda*. *H. postica* can be distinguished from *H. quadrioculata* by the posterior margin of the pronotum being densely macrosetiferous, while in *H. quadrioculata* the pronotum appears macrosetiferous along both the anterior and lateral margins, but posterior margin is not (Fig. 265).

Description

Length: 2.5-3mm; width: 1.8-2mm. Dorsum brownish, sparsely macrosetiferous. Macrosetae slender, longer than the length of abdominal tergum 1.

Head apparently glabrous and pale, except for two distinct transverse rows of setae confined to the vertex (Fig. 247). Clypeolabrum narrowed apically with apical margin concave (Fig. 247).

Pronotum with macrosetae densely fringing the marginal areas, with the discal area sparsely macrosetiferous (as in Fig. 264). Elytron with only the apical area (including lateroapical margin) finely setiferous. The remaining surface of the elytron is macrosetiferous with all macrosetae subequal in size.

Anterior surface of all femora finely setiferous. Abdominal terga subequal in length. Macrosetae apparently confined to the posterior half of terga 1 to 8. Pygidium apparently glabrous.

Urogomphi as seen ventrally with the outer lobe varying from subrounded to elongate kidney-shaped (Figs. 255-256), and with the inner lobe greatly reduced in size.

Hyperaspis oculaticauda Casey
(Figs. 246, 254, 260, 264)

Specimens examined

The study was based on five pupae from K. S. Hagen's collection, collected in Plumas Co., California. Two pupae are deposited in the Entomology Museum at Michigan State University. The remaining specimens are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

See diagnosis of *H. postica* for separation of these two species.

Description

Length: 2.5mm; width: 1.5mm. This species is very similar to *H. postica* in many respects except that the vertex is armed with only a single transverse row of macrosetae (Fig. 246), and the macrosetae on the elytron are sparser and become gradually more slender toward the sutural, scutellar and basal areas (Fig. 260). Outer lobe of the urogomphus as seen ventrally appearing elongate kidney-shaped (Fig. 254).

Hyperaspis cincta Leconte
(Fig. 252)

Specimens examined

The study was based on ten pupae from K. S. Hagen's collection, collected in Fresno Co., California. Two pupae are deposited in the Entomology Museum at Michigan State University. The remaining specimens are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

Hyperaspis cincta and *H. psyche* are the only available pupae whose macrosetae on the dorsum appear rather stout, with the setal length never exceeding the length of abdominal tergum 1. This differs from the pupae of the remaining available *Hyperaspis* species whose macrosetae are more slender, and whose setal length usually exceeds the length of abdominal tergum 1. Moreover, this species can be separated from *H. psyche* by the macrosetae being uniformly distributed over the elytral surface (excluding the apical area). In *H. psyche* the macrosetae at the basal one-fifth of the median area appear sparser than on the surrounding areas.

Description

Length: 3-3.5mm; width: 1.5-2mm. Dorsum shining brown and densely macrosetiferous. Macrosetae stout, with the setal length shorter than the length of abdominal tergum 1.

Head apparently glabrous except the vertex is densely macrosetiferous.

Pronotum with macrosetae fringing the marginal areas, and the discal area apparently without macrosetae.

Elytron with apical area including lateroapical margin finely setiferous; the remaining area is densely and uniformly macrosetiferous.

Anterior surface of all femora apparently glabrous. Abdominal terga densely and uniformly macrosetiferous except for the apparently glabrous pygidium. Abdominal pleura glabrous except for pleura 3 to 7 which usually have macrosetae confined to the outer lateral marginal area.

Urogomphus as seen ventrally with the outer lobe large, slender and sickle-shaped. Inner lobe greatly reduced in size (Fig. 252).

Hyperaspis psyche Casey
(Figs. 250, 261)

Specimens examined

The study was based on 10 pupae from K. S. Hagen's collection. Two pupae are deposited in the Entomology Museum at Michigan State University, the remaining specimens are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

See diagnosis of *H. cincta* for the separation of these two species.

Description

Length: 2.5-3mm; width: 1.2-1.5mm. This species is very simlar to *H. cincta* in many respects except that the macrosetae appear sparser on the dorsum, especially on the abdominal terga where they tend to be denser on the posterior half of each tergum. The macrosetae on the elytron are not as uniformly distributed over the elytral surface as *H. cincta,* excluding the apical area where microsetae replace the macrosetae. Macrosetae appear distinctly sparser in the basal one-fifth of the median area than elsewhere on the elytron of *H. psyche* pupae.

Hyperaspis quadrioculata (Motschulsky)
(Figs. 253, 265)

Specimens examined

The study was based on a single pupa from K. S. Hagen's collection, collected in San Mateo Co., California. The pupa is returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

This is the only available pupa that has the pronotum apparently glabrous except for the macrosetiferous anterior and lateral margins. This differs from the pupae of the remaining available species in which the pronotum is either densely setiferous over the dorsal surface or the macrosetae fringe the marginal areas.

Description

Length: 3.5mm; width: 2.2mm. Dorsum pale yellowish and rather sparsely macrosetiferous.

Head pale and apparently glabrous except for 2 groups of macrosetae (8 setae in each group) on the single available pupa.

Pronotum almost entirely glabrous, especially on discal area and posterior margin, while macrosetae fringe the anterior and lateral marginal areas (Fig. 265). Meso- and metanotum also appear almost entirely glabrous except for the presence of a few macrosetae along posterior margin.

Elytron sparsely macrosetiferous except for apical area and lateroapical margin being finely setiferous.

Anterior surface of all femora finely setiferous.

Macrosetae on abdominal terga rather sparse, but tending to be denser in posterior half of each tergum. Pygidium apparently glabrous.

Urogomphus as seen ventrally with the outer lobe broadly elongate oval (Fig. 253), and with the inner lobe greatly reduced in size.

Hyperaspis octavia Casey
(Figs. 248, 251, 259)

Specimens examined

The study was based on two pupae from K. S. Hagen's collection, collected in Michigan. The pupae are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

This species represents a group of available pupae including *H. quadrivittata* whose pygidium is macrosetiferous. This also occurs in *H. binotata* and *H. lateralis,* however, these two species differ considerably from *H. octavia* and *H. quadrivittata* by their densely macrosetiferous head, pro- and mesofemora. In *H. octavia* and *H. quadrivittata* the head (excluding the vertex) and all femora are apparently glabrous. Moreover, *H. octavia* can be separated from *H. quadrivittata* by the macrosetiferous apical area and lateroapical margin of the elytron, whereas *H. quadrivittata* has the apical area of the elytron finely setiferous.

Description

Length: 2.5-3.5mm; width: 1.5-2mm. Dorsum brownish and densely macrosetiferous. Setae appear slender, with the setal length about as long as the length of abdominal tergum 1.

Head pale and apparently glabrous excluding the densely macrosetiferous vertex (Fig. 248).

Pronotum finely setiferous discally, whereas the marginal areas are fringed with macrosetae.

Elytron densely macrosetiferous, including the apical area and lateroapical margin (Fig. 259).

Anterior surface of all femora finely setiferous. Abdomen densely macrosetiferous dorsally including pygidium. Urogomphus as seen ventrally with outer lobe subrectangular, with the inner anterior angle slightly pointed and curved mesally, the inner lobe small, rounded or elongate-oval (Fig. 251).

Hyperaspis quadrivittata Leconte
(Figs. 257, 258, 262, 263)

Specimens examined

The study was based on three pupae from K. S. Hagen's collection collected in Plumas Co., California. One pupa is deposited in the Entomology Museum at Michigan State University, the remaining pupae are returned to K. S. Hagen, University of California, Berkeley, California.

Diagnosis

This is the only available species which has the urogomphi greatly reduced in size with the inner lobe wanting. This separates this species from the remaining available *Hyperaspis* pupae which always have the inner urogomphal lobe present. See the diagnosis of *H. octavia* for the separation of these two species.

Description

Length: 2.5-3mm; width: 1.2-1.5mm. Dorsum yellowish and regularly macrosetiferous. Setal length as long as or longer than the length of abdominal tergum 1.

Head finely setiferous except for the densely macrosetiferous vertex (as in Fig. 248).

Pronotum densely macrosetiferous with macrosetae distributed uniformly over the dorsal surface (Fig. 263).

Elytron densely macrosetiferous excluding the finely setiferous apical area and lateroapical margin (Fig. 262).

Anterior surface of all femora finely setiferous. Abdomen densely and regularly macrosetiferous dorsally, including the pygidium.

Urogomphus as seen ventrally appearing simple with inner lobe absent. Outer lobe small, rounded to subrounded and sometimes subkidney-shaped (Figs. 257, 258).

Genus THALASSA Mulsant

Thalassa montezumae Mulsant
(Figs. 16, 208, 209, 236)

Specimens examined

The study was based on one pupa and one exuvia of *Thalassa montezumae* from the U.S. National Museum, collected from Harlingen, Texas, 13 September 1932.

Diagnosis

The apparently glabrous dorsum of the body, except for the marginal areas which are densely and coarsely setiferous, distinctly separates this species from *Hyperaspis* whose body is densely, coarsely and homogeneously setiferous.

Description

Length: 6mm; width: 4-4.5mm. Body large, broadly-rounded oval.

Head brown, with bristle-like setae confined to vertex and upper portion of frontal area; the rest of the head covered with fine and slender or short conical setae (Fig. 16).

Pronotum with anterior margin deeply concave and greatly expanded laterally, with the posterior lateral side descended beyond the lower margin of the eye. Body surface brown and covered with fine, slender setae, except for the yellowish marginal areas which are fringed with long, bristle-like setae (Figs. 16, 236). Meso- and metanotum apparently glabrous and brownish except for the yellowish scutellar area. Elytron brown, densely and finely setiferous, except for sutural and lateral margins which are fringed with long, bristle-like, stout setae. Legs robust with finely setiferous femora.

Abdominal terga brownish (except the first 2 yellowish), broadly tuberculate laterally, where dense, bristle-like setae are confined (Fig. 236). Abdominal pleura subquadrate, invisible from above, and fringed with bristle-like setae on the lateral margins (Fig. 236). Abdominal spiracles absent.

TRIBE SCYMNINI

Diagnosis

This tribe, in a general way, is very similar to the Hyperaspini, but the antennae (Figs. 58, 59) have a distinct club and the abdominal spiracles are normally present. Moreover, the homogeneous sclerotization of the head capsule, with the frontal suture wanting, and with dense setae on the labrum, femora and pygidium separates this tribe from Stethorini which characteristically possess the membranous frontal area, the glabrous labrum, legs, and pygidium.

Key to Genera of the Available Pupae of Scymnini

1 Body uniformly and densely setiferous; anterior surface of antenna scape glabrous (Fig. 58); pronotum projected caudad at mediobasal area into a turbercle-like rounded lobe (Fig. 109), and apical margin continuous with the vertex of head (Fig. 30); maxillary palpi glabrous ..... SCYMNUS Kugelann

1' Body apparently densely and coarsely setiferous only along marginal areas (Fig. 241); anterior surface of antennal scape setiferous (Figs. 31, 59); pronotum with basal margin arcuate, mediobasal area normal and apical margin not continuous with the vertex of the head; maxillary palpi monosetose (Figs. 31, 85) ..... CRYPTOLAEMUS Mulsant

Genus SCYMNUS Kugelann

Scymnus creperus Mulsant
(Figs. 30, 58, 109, 162, 201)

Specimens examined

The study was based on a single pupa of *Scymnus creperus* from the U.S. National Museum, collected in Amherst, Massachusetts, on 18 July 1941 by M. E. Smith and identified by E. A. Chapin.

Diagnosis

Species of *Scymnus* are quite different from *Stethorus* for the head is slightly and homogeneously sclerotized and all abdominal spiracles are normal, whereas in *Stethorus* the frontal area is membranous and usually protuberant and the first abdominal spiracles are prominently pedunculate.

Description

Length: 3mm; width: 1.5mm. Body generally pale or yellowish, slightly elongate oval, and very densely setiferous.

Head pale, homogeneously sclerotized and setiferous, vertex largely visible from above. Antennae short, extending to about one-third of the distance between the eye and the widest lateral margin of the pronotum. Antennal scape projected caudally into a short spine-like process (Fig. 58). The first 2 segments of the flagellum distinctly enlarged, and the club with papillae rather well developed. Clypeolabrum shorter than wide, with lateral sides rounded and apical margin truncate. Mandibles bifid. Maxillary palpi slightly enlarged apically.

Pronotum immarginate, with apical margin continuous with vertex of the head (Fig. 30). Mediobasal area expanded caudally into a large tubercle-like rounded lobe (Fig. 109). Elytron homogeneously and densely setiferous, including the apical and sutural margins. Hind wings glabrous. Legs short and robust, with anterior surface of femora densely setiferous. Metacoxae widely separated, the distance twice as great as between the procoxae (Fig. 238).

Dorsum of abdomen pale or yellowish and densely setiferous, with 2 types of setae. The macrosetae are twice the length of microsetae and consistent in location. They can be distinguished on each tergum as dorsal setae (usually a group of 3 somewhat transversely aligned setae), and subspiracular setae (usually a group of 2 setae). Pygidium small and very densely setiferous. Urogomphi cylindrical and very slender (as long as or slightly longer than the 8th abdominal tergum), with the distal end very slightly curved ventrally (Fig. 201). Abdominal spiracles subcircular and normal. Abdominal pleura subquadrate or rhomboidal and very densely setiferous, especially along outer lateral half. Ventral side of abdomen pale and sparsely setiferous.

Genus CRYPTOLAEMUS Mulsant

Cryptolaemus montrouzieri Mulsant
(Figs. 31, 59, 85, 205, 206, 241)

Specimens examined

The study was based on 4 pupae of *Cryptolaemus montrouzieri* from the U.S. National Museum, collected in Honolulu, Hawaii, 1 September 1894.

Diagnosis

This is the only known species of the Scymninae which has the antennal scape setiferous on the anterior surface (Figs. 31, 59) and with the maxillary palpus monosetose at apex (Figs. 31, 85). *Cryptolaemus* can also be separated from *Scymnus* by the appearance of dense and coarse setae confined along the marginal areas of the body as seen dorsally. Furthermore, the urogomphi of *Scymnus* are slender and straight, whereas in *Cryptolaemus,* the urogomphi prominently branch mesally into a large sausage-like process (Figs. 205, 206).

Description

Length: 4-5mm; width: 2.5-3.5mm. Similar to *Scymnus* in many respects except the following.

Body moderately large in size; in general, very densely and coarsely setiferous along marginal areas of the body.

Head pale, finely setiferous except the labrum and antennal scape which have long and slender setae. Antennae short, extending only half the distance between the eye and the widest lateral side of the pronotum; club with 4 rings of well developed papillae; flagellum short and subquadrate in cross section; scape somewhat rounded and setiferous on anterior surface (Fig. 59). Clypeolabrum wider than long with apical margin very narrow and slightly concave. Labral surface (including margins) densely setiferous. Maxillary palpi monosetose at apex (Fig. 31).

Pronotum brownish, immarginate, densely and coarsely setiferous along lateral and basal margins. Meso- and metanotum brownish and apparently glabrous. Elytron brownish but pale at apex and epipleura; surface apparently glabrous except for sutural, apical and lateral margins which are densely and coarsely setiferous (Fig. 241). Hind wings glabrous. Legs coarsely setiferous on anterior side of distal ends of femora (Fig. 31). Metacoxae narrowly separated.

Abdomen brownish and apparently glabrous dorsally, except that the lateral margins of each abdominal tergum are broadly tuberculate and armed with dense and coarse setae. Pygidium finely setiferous dorsally. Urogomphi short and stout; as much sclerotized as the immediately previous tergum, and projected medially into a long sausage-like process (distal disk) (Fig. 205). Abdominal pleura semi-sclerotized, tuberculate dorsally and laterally and armed with dense and coarse setae along lateral margins (Fig. 241) except pleura 1, 8 and 9 which are glabrous. Abdominal sterna pale and finely setiferous.

TRIBE STETHORINI

Genus STETHORUS Weise

Diagnosis

This is the only known tribe of Coccinellidae in which the frontal area of the pupae is membranous and usually protuberant (Figs. 17-22). This character separates Stethorini from all other groups of the family where the pupal head capsule is homogeneously sclerotized. *Stethorus* is also characterized by having one pair of prominent tubercles at the base of the pronotum (Fig. 110). This character indicates some degree of affinity to *Scymnus* which has a single broad, rounded lobe directed caudally at the base of the pronotum (Fig. 109).

Description

Length: 1.50mm-1.60mm; width: 0.9mm-1mm. Body shiny brownish, somewhat flattened dorsoventrally, elongate oval, tuberculated, and coarsely setiferous. Head pale, eyes very large and sub-rounded. Frontal suture sharply visible (Figs. 17, 19, 21). Frontal area entirely membranous, often protuberant (Figs. 20, 22). Antennae long, with very well-developed papillae arranged in 3 rings, but with the last two rings incomplete by lacking the dorsal and lateral papillae. Clypeolabrum glabrous and subrectangular, much shorter than wide, with apical margin deeply concave (Figs. 17, 19, 21). Mandible unequally bifid at tips. Maxillary palpi large and cylindrical. Labial palpi slender and cylindrical.

Pronotum shiny brown, immarginate and broadly bituberculate mediobasally, with posteriolateral angle angulate (Fig. 110). Elytron elongate oval, brownish and coarsely setiferous, with the epipleura wide. Hind wings brownish at apex and glabrous. Legs short, robust and glabrous; metacoxae widely separated, twice as widely separated as procoxae (Fig. 238).

Abdomen compact, segments subequal in length and somewhat densely tuberculate dorsally. Pygidium small, whitish and glabrous. First pair of abdominal spiracles prominently pedunculate (Figs. 190-192), the rest normal and circular (Fig. 237). Urogomphi rather long, straight, and slightly flared at distal end into an oval flat disk (Figs. 210, 211). Abdominal pleura conspicuously setiferous, subrhomboidal and curved ventrally. Ventral side of abdomen entirely pale, each sternum with one pair of median prominent setae except sterna 1, 2, 8 and 9.

Key to Species of the Available Pupae of *Stethorus*

1 Body sparsely setiferous, tubercles on mesonotum and subscutellar area of elytron prominent (Fig. 237); first abdominal spiracle somewhat flattened laterally and short (Fig. 192); 2nd abdominal pleuron glabrous ..... *Stethorus atomus* Casey

1' Body densely setiferous, tubercles on mesonotum and subscutellar area of elytron obsolete; first abdominal spiracle very slender and cylindrical (Figs. 190, 191); 2nd abdominal pleuron setiferous 2

2(1') Body dark and shiny brown, the membranous area on the frons large, broadly oval, seldom protuberant, with surface slightly concave; abdominal pleuron with more than 10 setae ..... *Stethorus punctum* Leconte

2' Body pale brownish, the membranous area on the frons small, circular and usually protruded into a short cylindrical process (Fig. 20); abdominal pleuron with less than 10 setae ..... *Stethorus picipes* Casey

Stethorus atomus Casey
(Figs. 21, 22, 110, 192, 210, 211, 237, 238)

Specimens examined

The study was based on 7 pupae from U.S. National Museum collected in association with adults in Brownsville, Texas, 3 September 1957 by U. L. Stegman and determined by E. A. Chapin.

Diagnosis

This is the only known species of *Stethorus* which has the first abdominal spiracles with a short and somewhat flattened but conspicuous peduncle (Fig. 192). All other known species have the first abdominal spiracles slender and cylindrical (Figs. 190, 191).

Description

Length: 1.5mm; width: 0.9mm. Body bronze brownish; prominently tuberculated dorsally.

Head strongly sclerotized, especially on vertex except for the membranous and protuberant oval frontal area. Antennae short and well papillated. Scape and the first segment of flagellum largely expanded caudally along lower side (Fig. 21). Clypeolabrum glabrous, wider than long, narrowed apically and deeply concave at apical margin (Fig. 21).

Mediobasal tubercles on the pronotum large, with 2 to 4 setae on each (Figs. 22, 110). Mesonotum with one large and prominent dorsal tubercle at the scutellar area bearing 2 pairs of setae (actually a pair of tubercles entirely fused together) (Fig. 237). Metanotum depressed dorsally, with tubercles greatly reduced in size and bearing 3 pairs of dorsal setae and one pair lateral setae (Fig. 237). Elytron very elongate oval, setae on discal area more sparse than on lateral margin; sutural and apical margins glabrous, but subscutellar area prominently tuberculate (Fig. 237). Hind wing somewhat strongly sclerotized at apical area and glabrous. Legs brownish at tibio-femoral joints.

Dorsum of the abdomen brownish except for the pale last segment. First abdominal spiracles flattened laterally, with base wider than one-half the length of 1st abdominal tergum (Figs. 192, 237). Each abdominal tergum usually with one pair of dorsal tubercles bearing 3 setae on each, and one pair of subspiracular tubercles bearing 2 setae, except tergum 1 in which the subspiracular tubercles are wanting, and terga 8 and 9 which are entirely glabrous. Pygidium pale translucent white; urogomphi cylindrical, as long as the 8th sternum, slightly flared distally and ending in a flat subcircular disk more or less perpendicular to the urogomphal axis (Figs. 210, 211). Abdominal pleura rhomboidal and curved ventrally; each pleuron with 4 setae occupying the outer half except for pleura 1, 2, 8 and 9 which are glabrous. Ventral abdomen pale; sterna 4, 5, 6, and 7 each with one pair of median setae; sternum 3 largest with 2 pairs of anteriomedial and posteriomedial setae.

Stethorus picipes Casey
(Figs. 19, 20)

Specimens examined

The study was based on 9 pupae from the U.S. National Museum, collected in Yakima, Washington, 4 September 1925.

Diagnosis

This species can be separated from *Stethorus atomus* by being more densely setiferous and paler, with the 1st abdominal spiracle very slender and cylindrical (as long as or longer than adjacent setae) (Fig. 190), and the lack of a large scutellar tubercle on the metanotum.

Description

Length: 1.6mm; width: 1mm. Similar to *Stethorus atomus* except for the following characters: In general, body paler and more densely setiferous, however, setae much more slender and slightly curved distally.

Head pale with membranous area on the frons circular and sometimes protruding into a short cylindrical process (Fig. 20). Antennal papillae not well developed and greatly reduced in number. Mediobasal tubercles on the pronotum more densely setiferous and each with more than four setae. Scutellar tubercles on the mesonotum much reduced in size or wanting. Discal area of elytron as densely setiferous as lateral margin.

First abdominal spiracles cylindrical, slender and as long as the neighboring setae (Fig. 190), the diameter of spiracular opening equal to that of the spiracles on the second segment. Abdominal pleura densely setiferous (6-8 setae on each) except that pleura 1, 8 and 9 are glabrous and pleuron 2 bears two to three setae.

Stethorus punctum Leconte
(Figs. 17, 18, 190, 191)

Specimens examined

The study was based on 1 pupa and 3 exuviae from the U.S. National Museum, collected in a greenhouse in Amherst, Massachusetts, 22 July 1942, by M. E. Smith.

Description

Very similar to *Stethorus picipes,* except body darker and more shiny. The membranous area on the frons is large and broadly oval, with the surface slightly concave (Figs. 17, 18). First abdominal spiracles with peduncle brownish, somewhat conical, and shorter than neighboring setae (Fig. 191).

SUBFAMILY CHILOCORINAE

TRIBE CHILOCORINI

Diagnosis

Members of Chilocorini are very easily recognized by the greatly dilated epistoma which is expanded laterally to conceal the antennal bases (Fig. 23).

Similar to the Stethorini in that one pair of well pedunculated spiracles is also present in all members of the Chilocorini, but here the peduncle is more strongly sclerotized and more prominent.

Furthermore, the pupae of Chilocorini are often easy to recognize by having the pupa enclosed in the last larval exvuvium except for a dorsolongitudinal slit which exposes the pupa.

Key to Genera of the Available Pupae of Chilocorini

1 First abdominal segment with one pair of pit-like gland openings located between anterior and posterior margins of the first abdominal tergum and metanotum respectively (Figs. 239, 240) 2

1' First abdominal segment without such a pair of pit-like gland openings 4

2(1) Pronotum crescent-shaped with anterior angle subacute (less than 90°) (Figs. 106, 107); legs somewhat slender, with long tarsi, the width of terminal segment is one-fourth as long as dorsal length of the tarsus (Fig. 104); size under 4mm in length 3

2' Pronotum U-shaped with anterior angle near 90° (Fig. 105); legs short and robust, tarsi not as long, with the width of terminal segment more than one-fourth as long as dorsal length of the tarsus (Fig. 103); size large, over 5mm in length ..... AXION Mulsant

3(2) Spiracular peduncle long, with the outer lateral side viewed from metanotum more than three times as long as the diameter of spiracular opening (Fig. 187); dorsal surface inconspicuously spinose, with spines less than one-half of setal length *Brumoides suturalis* ..... BRUMOIDES Chapin

3' Spiracular peduncle short, with the outer lateral side viewed from metanotum less than three times as long as the diameter of spiracular opening (Figs. 185, 186); dorsal surface conspicuously spinose, with spines one-half as long as setae ..... EXOCHOMUS Redtenbacher

4(1') Size large, over 5mm in length, with large bristle-like setae on dorsal surface (Figs. 23, 242); base of labrum much narrower than apex of clypeus (Fig. 23) .....CHILOCORUS Leach

4' Size small, under 5mm in length, with dense and long hair-like setae giving the body a fuzzy appearance (Fig. 29); never with bristle-like setae on dorsal surface; base of labrum subequal to apex of clypeus (Fig. 29), *Orcus chalybeus* .....ORCUS Mulsant

Genus CHILOCORUS Leach

Chilocorus bivulnerus Mulsant
(Figs. 23, 66, 67, 88, 93, 212, 213, 242)

Specimens examined

The study was based on 5 pupae of *Chilocorus bivulnerus* from the U.S. National Museum, collected in Florida.

Diagnosis

This species represents one group of species of Chilocorini including *Orcus chalybeus* that have no gland openings on the dorsum of first abdominal segment. The pupae of the remaining available genera (*Axion, Brumoides* and *Exochomus*) possess one pair of dorsal pit-like gland openings located between the anterior margin of the 1st abdominal tergum and the posterior margin of the metanotum (Figs. 187, 239). Thus, *Chilocorus* and *Orcus* appear to have strong affinities. *Chilocorus* can be separated from *Orcus* by the much shorter and coarse setae, and the labral base being much narrower than the clypeal apex (Fig. 23). In *Orcus* the setae appear very long and slender, giving the body a fuzzy appearance, and the labral base is as wide as the clypeal apex (Fig. 29).

Description

Length: 4.5-5mm; width: 2.5-2.8mm. Body elongate oval, entirely enclosed in the last larval exuvia, brownish, slightly rugose and finely setiferous. Epistoma largely dilated laterally and concealing antennal bases (Fig. 23). Antennae short and somewhat annulated, tapering apically and pointed at apex (Fig. 23). Labrum densely setiferous, small and much narrower than clypeal apex whose margin is slightly concave (Fig. 23). Mandible simple at tip (Figs. 66, 67). Maxillary palpi glabrous, large and subcylindrical (Fig. 88). Galea bulbous, glabrous and hook-shaped as seen from the top. Labial palpi cylindrical, slender, and rounded apically (Fig. 93).

Pronotum large, immarginate, "U" shaped, brownish and densely setiferous, with bristle-like setae on discal area. Mediolongitudinal line yellowish and very distinct, with anterior angles pale and finely setiferous. Meso- and metanotum brownish with 2 groups of discal bristle-like setae. Elytron immarginate along lateral margin,

brownish at base, then gradually lighter toward apex, and finely setiferous except for the subscutellar area which bears bristle-like setae (Fig. 242). Lateroapical angle obtuse and rounded; epipleura wide. Hind wings semi-sclerotized and glabrous, tapering apically, with apex rounded. Legs short, yellowish to light brown; femora robust (Fig. 23).

Abdominal terga brownish except the spiracular area of the 1st segment pale; posterior margin of terga 3 to 6 finely dentulate. Large bristle-like setae confined to one pair of dorsal tubercles on each tergum except terga 7, 8 and 9 where dorsal tubercles are nearly obsolete, and tergum 1, while large bristle-like setae are present on the subspiracular area. Pygidium minute in relation to the 8th tergum and finely setiferous. Urogomphi long, subcylindrical, tapering toward apex, and ending in a kidney-shaped disk (Figs. 212, 213). Abdominal spiracles circular and slightly pedunculate, with the peduncle of the first abdominal spiracle large and conspicuous (Fig. 242). Abdominal pleura partially visible from above, semi-sclerotized and subquadrate. Abdominal sterna pale yellowish, the 7th sternum very large and twice as long as the 8th. In the ♀, sternum 9 is distinctly bimammillate (Fig. 212).

Genus ORCUS Mulsant

Orcus chalybeus (Boisduval)
(Figs. 29, 214)

Specimens examined

The study was based on 30 pupae of *Orcus chalybeus* collected from Sydney, Australia, and deposited in the U.S. National Museum. However, because of poor condition of the specimens detailed studies of this species have been omitted.

Diagnosis

See *Chilocorus* diagnosis for the separation of these 2 species.

Description

Length: 3mm; width: 2mm. Body apparently setiferous, very fuzzy with long hair-like setae, and brownish on dorsal surface. Head wide, hexagonal, with base of labrum subequal to clypeal apex (Fig. 29), and apical margin of the labrum convex.

Pronotum brown with lateral margins greatly descended beyond the lower side of the eyes (Fig. 29). Elytron brown at the base and at the sutural area where long, hair-like setae are very dense. . . then gradually lighter toward apex and lateral margin. Abdominal terga brownish and very fuzzy, with long hair-like setae; the first abdominal segment with only one pair of short pedunculate lateral spiracles.

Genus AXION Mulsant

Diagnosis

This species is representative of one group of species of the Chilocorini with the dorsum of the first abdominal segment possessing one pair of gland openings located between the anterior margin of the first abdominal tergum and the metanotum. *Axion* differs from *Exochomus* and *Brumoides* by its very large size (over 5mm in length) and horseshoe-shaped pronotum (Fig. 105). In *Exochomus* and *Brumoides* the size is much smaller (under 5mm in length) and the pronotum is crescent-shaped (Figs. 106, 107).

Description

Length: 5.5mm; width: 4-4.5mm. Body broadly rounded-oval, brownish to very dark brown with yellowish spots; dorsal surface densely spinose (Fig. 25) and finely setiferous.

Head pentagonal (Fig. 24), brownish, with frontal area spinose. Antennae short, mostly hidden under pronotum and epistoma, the latter dilated laterally (Fig. 24), flagellum subquadrate in cross section, with distal end truncated and club indistinct (Fig. 63). Clypeolabrum as wide as distal end of epistoma and greatly narrowed apically (Fig. 24). Mandibles simple at tip and mola well developed (Figs. 64-65). Maxillary palpi trapezoidal, elongate oval in cross section, with sides subparallel (Figs. 24, 89). Labial palpi short, subcylindrical, with apex rounded (Fig. 94).

Pronotum large, "U"-shaped with apical margin deeply concave and surface densely spinose (Fig. 105). Prothoracic spiracle oval. Elytron elongate oval, lateroapical angle obtuse and rounded, lateral side immarginate. Epipleura wide and slightly concave, and elytral surface finely nodulated and densely spinose. Hind wing semi-sclerotized with apex rounded. Legs short and robust, with femorotibial joints brownish.

Abdominal terga without dorsal tubercles and densely spinose, each with 4 conspicuous groups of fine setae arranged in circles consisting of 2 dorsal and 2 lateral or spiracular setae. The area inside the ring of setae is often smooth. Urogomphi biramose, with distal ends mushroom-shaped and greatly enlarged (Fig. 215). Pygidium minute in relation to the 8th tergum and glabrous. Abdominal segment 1 with 1 pair of lateral, prominently pedunculate spiracles, and 1 pair of characteristic pit-like gland openings located between the anterior margin of the first abdominal tergum and the metanotum. Abdominal sterna smooth and pale, with sternum 7 twice as long as sternum 6.

Key to Species of the Available Pupae of *Axion*

1 Yellow spiracular spots on the first abdominal tergum present; the opening plane of the first abdominal spiracles perpendicular to peduncular axis (Fig. 188); peduncle pale yellowish ..... *Axion plagiatum* (Olivier)

1' Spiracular spots on the first abdominal tergum absent; the opening plane of the first abdominal spiracles oblique to the peduncular axis (Fig. 189); peduncle dark brown to black ..... *Axion tripustulatum* (DeGeer)

Axion plagiatum (Olivier)
(Figs. 24, 25, 63-65, 89, 94, 95, 103, 105, 188, 215, 239, 240)

Specimens examined

The study was based on 4 pupae associated with adults from the U.S. National Museum collected in Arizona, 19 June 1901, by Prescott, and from Los Angeles, California, by Coquillet.

Diagnosis

This species is separated from *Axion tripustulatum* by the presence of a large pair of subquadrate spiracular yellow spots on abdominal tergum 1, and the opening of the first abdominal spiracle being perpendicular to the peduncular axis, with the peduncle pale yellowish. In *tripustulatum,* the spiracular opening of the first abdominal segment is oblique to the peduncular axis, and the peduncle is dark brown or black.

Description

Length: 5.5mm; width: 3.5mm. Body rounded-oval and moderately convex dorsally.

Head light brown with spines confined in the frontal areas (Fig. 24). Pronotum dark brown, with two large discal yellow spots. Metanotum dark brown with mid-basal area yellow. Elytron dark brown at basosutural area, then gradually lighter toward apex and lateral margin. Abdominal terga dark brown except for medio-dorsal yellow areas; terga 6, 7, 8, 9 light brownish and the first abdominal tergum with 2 large subquadrate spiracular yellowish spots. Opening of the spiracles on abdominal tergum 1 perpendicular to the peduncular axis. Peduncle pale yellowish (Fig. 188).

Axion tripustulatum (DeGeer)
(Fig. 189)

Specimens examined

The study was based on three pupal exuviae from the U.S. National Museum, collected in association with adults in College Park, Maryland, on 14 July 1873, and on 4 July 1940, by C. V. Riley and W. H. Anderson respectively. Adults were identified by E. A. Chapin.

Description and diagnosis

Very similar to *A. plagiatum* except the spiracular area on the first abdominal tergum is brownish, and the opening of the spiracles on the first abdominal tergum is oblique to the peduncular axis, with the peduncle dark brown or black (Fig. 189).

Genus EXOCHOMUS Redtenbacher

Description

Very similar to *Axion* except size much smaller (3-3.5mm in length). Dorsum light brown, with yellowish spots. Pronotum crescent-shaped with apical angles subacute (Fig. 106). Legs somewhat slender, with long tarsi in which the diameter of terminal segment is about one-fourth as long as dorsal length of the tarsus (similar to Fig. 104). Body spines one half as long as setae.

Key to Species of the Available Pupae of *Exochomus*

1 Elytron and frons never spinose; labral apex truncate or slightly concave (Fig. 26); peduncular spiracles on the first abdominal segment cylindrical near the distal end (Fig. 185) ..... *Exochomus hoegei* Gorham

1' Elytron and frons with scattered spines; labral apex subacute or convex (Fig. 27); peduncular spiracles on the first abdominal segment conical, not quite cylindrical near the distal end (Fig. 186) ..... *Exochomus cubensis* Dimmock

Exochomus hoegei Gorham
(Figs. 26, 106, 189)

Specimens examined

The study was based on six specimens from the U.S. National Museum, collected in Douglas, Arizona, 2 October 1956, by J. H. Russel.

Diagnosis

This species can be easily separated from *Exochomus cubensis* by the concave clypeolabrum, with the spiracular peduncle cylindrical near the distal end. In *E. cubensis,* the spiracular peduncle is conical and the clypeolabrum is convex.

Description

Length: 3.5mm; width: 2.5mm. Head pentagonal (or hexagonal because of labral apex truncated or slightly concave). Antennae short, slightly elbowed, with the bases hidden under dilated epistoma (Fig. 26). Pronotum U-shaped, with basal margin arcuate and largely extended forward, pushing the lateral margins forward where the posteriolateral angles are very obtuse (Fig. 106). Dorsal surface of pronotum densely spinose medially, then gradually sparser laterally and with the margins never covered by spines. Mediodorsal surface of meso- and metanotum glabrous and smooth. Elytron finely setiferous and micronodulated but never spinose, brownish at base and along sutural area, and gradually lighter toward apex.

Mediodorsal areas of abdominal terga glabrous and smooth. First five abdominal terga brown except mediodorsal and spiracular areas yellowish; the rest immaculate and pale yellowish; tergum 8 entirely smooth. Peduncular spiracles of the first abdominal segment somewhat slender and cylindrical near the distal end (Fig. 185), and with the diameter of spiracular opening much less than that of the pit-like gland opening. Abdominal sterna pale, surface smooth.

Exochomus cubensis Dimmock
(Figs. 27, 186)

Specimens examined

The study was based on 2 pupae from the U.S. National Museum collected in Cuba by Dimmock.

Diagnosis and description

Similar to *Exochomus hoegei* in many respects except for the following.

Size from 3-3.5mm in length and 2-2.5mm in width. Frontal area and elytral surface spinose. Labral apex subacute or convex (Fig. 27). Peduncular spiracles of the first abdominal segment conical (Fig. 186) (in *E. hoegei*, the peduncular spiracles are cylindrical near distal end), the spiracular opening with the diameter as wide as or wider than that of the pit-like gland opening. Dorsally pale or very light brown, the first abdominal tergum pale yellowish with two large brownish subquadrate interspiracular spots located between gland opening and peduncular spiracle.

Genus BRUMOIDES Chapin

Brumoides suturalis (Fabricius)
(Figs. 28, 104, 107, 187, 216, 217)

Specimens examined

The study was based on 16 pupae of *Brumoides suturalis* reared by A. G. Selhime, from Florida, 1955, and deposited in the U.S. National Museum.

Diagnosis and description

Similar to *Exochomus* in many respects, except for the following.

Length: 3-3.5mm; width: 1.5-2mm. Body fusiform, finely setiferous and very inconspicuously spinose on dorsal surface where the spines are about one-third to one-fifth as long as the setae.

Head and dorsal surface pale yellowish. Pronotum crescent-shaped, with anterior angle subacute (Fig. 107), usually pale yellowish or very light brown, especially on mediodorsal area. Peduncular spiracles on the first abdominal segment conical and long; peduncle height may exceed the distance along posterior margin of the metanotum between the pit-like laterodorsal gland opening and the elytral sutural impression line (Fig. 187).

SUBFAMILY COCCINELLINAE

Diagnosis

This is the largest group of the family, consisting of the tribes Coccinellini, Psylloborini and Discotomiini. Pupae of the latter were not available. Pupae of Coccinellinae are characterized by the exposed intersegmental conjunctivae between the abdominal terga 3 and 4, 4 and 5, 5 and 6, and 6 and 7, allowing for a strongly flexible abdomen, and by having very fine setae which give the body an apparent glabrous aspect. In addition, the dorsum of the pupa of the Coccinellinae is distinctly maculate (even though adults of some species may be immaculate), while all other members of the family are usually immaculate and pale or brownish throughout (even though adults of some species may be maculate).

TRIBE COCCINELLINI

Diagnosis

This tribe according to several authors is divided into several different tribes such as Coccinellini, Hippodamini, Anisostictini, and Synonychini. But, as Boving (1917), Savoiskaya (1960) and Sasaji (1968a,b, 1971) have pointed out, there are many intermediate characters among these "tribes," and the group should be regarded as a single tribe, the Coccinellini, as we do here.

Pupae of the Coccinellini and Psylloborini are almost identical morphologically, except that the mouthparts are somewhat modified to suit the fungiphagous habit in the Psylloborini. The clypeolabrum is much wider than long, with the apical margin truncate, the maxillary palpi have the apex broadly expanded (twice as wide as the base), and the galea is greatly enlarged, with the greatest width as wide as the base of the maxillary palpus.

In contrast, in the Coccinellini, the clypeolabrum is as long as, or slightly longer than wide, with the apical margin usually concave, the maxillary palpi have the width of the apex subequal to that of the base, and the galea is usually small, with the greatest width one half as wide as the base of the maxillary palpus.

Key to Genera of the Available Pupae of Coccinellini

1 Legs long, with front femora extended considerably beyond the widest lateral margins of the pronotum (Figs. 41, 43, 49) 12

1' Legs short, with front femora not extended beyond the widest lateral margins of the pronotum (Figs. 32-36) 2

2(1') Hind wing apex finely and densely spinulate (Figs. 179-184) 3

2' Hind wing apex smooth or micronodulate 4

3(2) Elytral surface densely spinulate (Fig. 8); only ventromarginal areas of hind wing *apex* finely and densely spinulate (Figs. 181-183); prothoracic spiracle elongate oval (Fig. 194) .....COCCINELLA Linnaeus

3' Elytral surface smooth, *both* dorso- and ventromarginal areas of hind wing *apex* finely and densely spinulate (Figs. 179-180); prothoracic spiracle rounded (Fig. 193) *Adalia bipunctata* (Linnaeus) .....ADALIA Mulsant

4(2') Urogomphi branched mesally into a spine-like process at the basal one-third (Figs. 221-226) 5

4' Urogomphi not branched mesally (Figs. 227, 228) 9

5(4) Abdominal pleura 3 to 5 with posterior lateral angle projected into a long spine-like process (Figs. 176-178); antennal club indistinct, with the diameter subequal to that of the flagellum (Figs. 54-55) 7

5' Abdominal pleura 3 to 5 subquadrate, with posterior lateral angle only slightly expanded laterocaudally (Fig. 171); antennal club distinct and subspherical, with the diameter much larger than that of the flagellum (Figs. 34, 52) 6

6(5') Antennal scape strongly convex anteriorly and distinctly separated from the flagellum (Fig. 34); body rounded, apparently glabrous; posterior lateral angle of abdominal pleura 3 to 5 slightly rugose, *Olla abdominalis* (Say) .....OLLA Casey

6' Antennal scape flattened anteriorly and hardly separated from the flagellum (Fig. 40); body slightly elongate oval and finely setiferous; posterior lateral angle of abdominal pleura 3 to 5 deeply rugose and punctate (Fig. 171), *Neoharmonia venusta* (Melsheimer) .....NEOHARMONIA Casey

7(5) Abdominal pleura with the spine-like process projected laterocaudad and short, not exceeding the greatest width of the corresponding pleuron (Figs. 177-178); antennae long, extending over two-thirds of the distance between the widest lateral margin of the pronotum and the eye (Figs. 32, 45) 8

7' Abdominal pleura with the spine-like process projected lateroanterad and long, exceeding the greatest width of the corresponding pleuron (Fig. 176); antennae short, extending to about half the distance between the widest lateral margin of the pronotum and the eye, *Synonycha grandis* (Thunberg) . . . . . SYNONYCHA Mulsant

8(7) Apical margin of clypeolabrum slightly concave (Fig. 45); spots large, almost covering the entire segment, but poorly defined; setae coarse, borne on a conspicuous tubercle with distal end strongly curved (Fig. 177) *Anisocalvia quatuordecimguttata* Linnaeus . . . . . ANISOCALVIA Crotch

8' Apical margin of clypeolabrum sinuate or slightly convex (Fig. 32); spots smaller, with a well defined border; setae finer, borne on a flat cuticular ring on an inconspicuous tubercle . . . . . ANATIS Mulsant

9(4' Antennae very long, if straight, then extending beyond the widest lateral margins of the pronotum (Figs. 44, 56); flagellum C-shaped; antenna with six rings of papillae; club not so distinct, with the diameter subequal to that of the flagellum (Fig. 56); body rather coarsely setiferous, with chalaza-type setae, especially along lateral margin of abdominal pleura 3 to 5 (Fig. 172), *Propylaea quatuordecimpunctata* (Linnaeus) . . . . . PROPYLAEA Mulsant

9' Antennae shorter, if straight, not extending beyond the widest lateral margins of the pronotum; flagellum slightly elbowed; antenna with less than six rings of papillae; club distinct, with the diameter greater than that of the flagellum (Figs. 52, 53); body apparently glabrous or finely setiferous, with setae borne on a flat cuticular ring 10

10(9') Antennal club subspherical (Fig. 52); surface of the galea with less than five conspicuous fine teeth (Figs. 81, 82) 11

10' Antennal club cylindrical-elongate or subrectangular block-shaped (Fig. 53); surface of the galea with at least five conspicuous fine teeth (Fig. 80) .....MULSANTINA Weise

11(10) Antennae actually with three rings of papillae; scape greatly swollen (Fig. 34); body apparently glabrous and rounded, pale silky white dorsally, *Olla abdominalis* (Say) .....OLLA Casey

11' Antennae actually with four rings of papillae (Figs. 38, 39); scape flat and not so distinct from flagellum; body finely setiferous, yellowish, and slightly elongate-oval .....CYCLONEDA Crotch

12(1) Exposed conjunctivae on abdominal segments 4 to 7 glabrous; elytron with lateral angle broadly expanded anteriorly into a distinct rounded lobe (Figs. 158, 159) .....HIPPODAMIA Dejean

12' Exposed conjunctivae on abdominal segments 4 to 7 finely setiferous; elytron with lateral angle obtuse and rounded, almost continuous with the lateral margin; never expanded anteriorly into a distinct lobe (Figs. 155, 156).....13

13(12') Apical margin of clypeolabrum deeply notched (Fig. 49); anterior margin of pronotum non-marginate; lateral margin of abdominal pleura 3-4 slightly angulate (Fig. 175), *Eriopis connexa* (Germar) .....ERIOPIS Mulsant

13' Apical margin of clypeolabrum slightly concave (Figs. 42, 43); anterior margin of pronotum strongly marginate (Figs. 124-126); lateral margin of abdominal pleura 3-4 rounded convex (Fig. 174) 14

14(13') Lower side of anterior edge of the pronotum descending to two-thirds of the eye length (Fig. 42); first abdominal spiracles entirely hidden under the elytra, *Naemia seriata* (Melsheimer) .....NAEMIA Mulsant

14' Lower side of anterior edge of the pronotum never descending to two-thirds of the eye length (Fig. 43); first abdominal spiracles mostly hidden under the elytra, *Coleomegilla maculata DeGeer*
. . . . . COLEOMEGILLA Timberlake

Genus COCCINELLA Linnaeus

Diagnosis

Coccinella represents one group in the subfamily Coccinellinae in which the body is usually rounded-oval, moderately convex dorsally, and with short legs in which the front femora never extend beyond the widest lateral margins of the pronotum as viewed ventrally. By contrast, in the other group as represented by *Hippodamia, Coleomegilla, Eriopis, Paranaemia* and *Naemia*, the body is elongate-oval, and has long legs in which the front femora extend considerably beyond the widest lateral margins of the pronotum. *Adalia* is very similar to *Coccinella.* The elytral surface is clothed with fine sharp spines in *Coccinella,* whereas in *Adalia,* the elytral surface is smooth. In addition, in *Adalia,* both dorsal and ventral surfaces of the *hind* wing *apex* are clothed with fine sharp spines (Figs. 179, 180), whereas in *Coccinella,* only the ventral surface of *hind* wing *apex* is sharply spinulated (Figs. 181-183). These two genera are quite different from the remainder of Coccinellini whose *hind* wing *apex* is usually smooth.

Description

Length: 5.5-8mm; width: 4-5mm. Body slightly elongate oval, strongly convex dorsally and finely setiferous.

Head somewhat hexagonal, slightly longer than wide, surface deeply rugose, brown to black, frontal area usually pale whitish or light yellow. Mediolongitudinal line well defined throughout the head length. Eye dark brown. Antennae long and slender, exceeding half the distance between the widest lateral margin of the pronotum and the eye (Fig. 35). Antennal club subspherical and distinct from flagellum, and with four rings of papillae, the 3rd and the 4th incomplete (lacking some lateral papillae), with the ventral papillae of the 4th flattened but visible. Flagellum slender and subquadrate in cross section; antennal scape suboval and convex anteriorly. Clypeolabrum usually dark brown, with lateral edge slightly sinuate. Labrum almost black, surface with deep longitudinal and subparallel wrinkles. Apical margin of the labrum concave or sinuate-concave (Fig. 35) and very narrow, about one half as wide as the base, with the lateral margin rounded convex. Mandibles bifid at tip, with mola well developed (Figs. 70, 71). Maxillary palpus large, trapezoidal, usually dark brown or black and rugose, with lateral margin slightly convex (Fig. 35). Galea smooth and brownish. Lacinea immediately beneath the galea with tip wedge-shaped. Labial palpus with deep longitudinal subparallel wrinkles.

Pronotum immarginate, usually yellowish with dark brown spots along marginal areas; mediolongitudinal line always present and the anterior margin deeply rugose. Mesonotum trapezoidal, usually yellowish or brownish with one pair of circular spots,

and the scutellar area elevated in the middle. Metanotum usually with two large oval spots at base where deep subparallel wrinkles are clearly visible. Prothoracic spiracle elongate oval (Fig. 194).

Elytron large, somewhat rectangular, with wide and slightly concave epipleuron; the lateroapical angle slightly expanded anteriorly, forming a somewhat rounded lobe (Figs. 141-152). Elytral surface densely covered with very fine sharp spines. Color pattern may change from light yellow with dark spots or transverse bands to very dark brown or black with small yellowish areas. Hind wing apex slightly sclerotized, finely and densely spinulated along ventrolateral and ventrosutural margins (Figs. 181-183).

Abdomen usually yellowish with dark brown spots on dorsal surface. Terga 4 to 6 slightly narrowed medially, and "detachable" from one another to show the intersegmental conjunctivae which are as strongly sclerotized as the terga and finely setiferous. Posterior margins of terga 3 to 6 finely and sharply dentulate. One pair of dorsal tubercles may be present on terga 2 to 8. Abdominal spiracles circular or nearly so, and gradually diminishing in size toward posterior of the abdomen; usually the first five spiracles well sclerotized. Abdominal pleura subquadrate with pleura one and two hidden and partly hidden under elytron respectively; pleura 8 and 9 somewhat fused together. Urogomphal disk bilobed, with inner lateral side of base straight (Fig. 219). Abdominal sterna immaculate, yellowish and finely setiferous. Third sternum the largest, with anterior margin deeply sinuate, and with 2 sublateral elevated curved lines caused by metafemoral depressions. In the ♂, the 9th sternum is flat and subrectangular, whereas, in the ♀, it is bibulbous, with the nipple-like tip well sclerotized (Figs. 2, 219).

Key to Species of the Available Pupae of *Coccinella*

1 Hind wing apex finely spinulated along ventrolateral and ventrosutural margins (Fig. 183); elytron with at least two transverse bands (Figs. 141-142) ..... *Coccinella trifasciata* Linnaeus

1' Hind wing apex finely spinulated along ventrolateral margin only (Figs. 181-182); elytron without transverse bands 2

2(1') Elytral surface more than half dark brown or black, not spotted (Fig. 148) 3

2' Elytral surface half or less than half dark brown or black, may have distinct spot(s) 5

3(2) Elytron with dark area(s) occupying over three-fourths of the total surface 4

3' Elytron with dark area(s) never occupying three-fourths of the total surface 7

4(3) Elytron with subhumeral and basal areas pale, and with a narrow pale stripe extending from outer apical angle to the distal end of lateral margin (Fig. 148); length of spinulated area on *hind* wing apex one-half as long as *elytral* apex (Fig. 181); pronotum yellowish with dark brown marginal areas and no spots ..... *Coccinella transversoguttata* Faldermann

4' Elytron with subhumeral and basal areas pale (Fig. 152); length of spinulated area on *hind* wing apex shorter than one-half of *elytral* apex (Fig. 182); pronotum brownish with darker margins and 2 pairs of circular and elongate oval pale spots ..... *Coccinella monticola* Mulsant

5(2') Elytron with median spot at basal two-fifths twice as wide as long (Fig. 145); subscutellar spot triangular and usually present (Figs. 146, 147) ..... *Coccinella transversoguttata* Faldermann

5' Elytron with median spot at basal two-fifths never twice as wide as long (Fig. 149); subscutellar spot oval if present 6

6(5') Elytral spots unequal; median spot at basal two-fifths subquadrate, larger or as large as metanotal spot (Fig. 149); disto-lateral spot absent ..... *Coccinella novemnotata* Herbst

6' Elytral spots subequal; median spot at basal two-fifths rounded, oval and much smaller than metanotal spot (Fig. 143); disto-lateral spot also rounded, oval, and located at distal end of lateral margin (Fig. 143) ..... *Coccinella septempunctata* Linnaeus

7(3') Subscutellar and humeral dark areas somewhat truncate anterad, with a well-defined contour (Fig. 144); a subscutellar spot may be distinct; mesonotal spot half as large as metanotal spot ..... *Coccinella septempunctata* Linnaeus

7' Subscutellar and humeral dark areas somewhat pointed anterad, and with not so well-defined contour (Figs. 150-151); subscutellar spot never present; mesonotal spot much less than half as large as metanotal spot ..... *Coccinella novemnotata* Herbst

Coccinella trifasciata Linnaeus
(Figs. 112, 141, 142, 183)

Specimens examined

The study was based on 25 pupae which were reared in the laboratory from adults collected in Clinton Co., Michigan, on 30 May 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This is only known species of *Coccinella* with a very well defined maculation pattern on dorsal surface of the body, with at least 2 transverse dark brown bands on each elytron, and frequently a third, and with the *hind* wing *apex* finely spinulated along *both* ventrolateral and ventrosutural margins. This is distinctly different from the remaining known species of *Coccinella* whose hind wing apex is only spinulated along the ventrolateral margin.

Description

Length: 6-6.5mm; width: 4-4.5mm. Body slightly elongate oval, finely setiferous and yellowish, with distinct dark brown spots and transverse bands on dorsum of the body.

Head with most of frontal area yellowish. Eyes and antennae dark brown. Antennal scape distinct, convex anteriorly. Club distinctly subspherical. Clypeus usually pale or light brown at base. Labrum with the apical margin concave and dark brown except for a mediolongitudinal whitish line. Mandibles unequally bifid at apex.

Pronotum with anterior margin dark brown except for the median area, one pair of large claw-shaped spots at posterior angles, and one pair of large subcircular spots at the base (Fig. 112). In dark forms, one pair of median light brown spots may be present. Meso- and metanotum yellowish, each with one pair of small circular and one pair of large oval spots. Elytron (Figs. 141, 142) always with sutural area and apex dark brown. Subscutellar spot triangular, separated or fused with a transverse band extending to humeral angle. The second and the third transverse bands extending from the median to lateral margin at basal two-fifths and three-fourths respectively. The third band may be reduced to a circular spot in light forms. Hind wing apex slightly sclerotized and very finely spinulated along ventrolateral and ventrosutural margins (Fig. 183).

Abdominal terga 2 to 6 each with one pair of large spots, the rest immaculate or with very light spots. Tergum 2 with undefined spots consisting of one pair of spiracular and one pair of small dorsal spots. Tergum 3 similar to 2 but with large,

subquadrate and subrectangular, more well-defined spots; the spiracular and dorsal spots may fuse together. Terga 4, 5 and 6 each with only one pair of subquadrate dorsal spots. Posterior margins of terga 3 to 6 dark brown or black at portions corresponding to spots, and very finely and densely spinulated (including the lower surface). Abdominal pleura immaculate and yellowish, except that pleura 2 and 3 are almost covered by a large subquadrate dark brown spot. All abdominal sterna yellowish and immaculate; sternum 9 flat in the ♂ and bibulbous in the ♀with the nipple-like tip well sclerotized.

Coccinella transversoguttata Faldermann
(Figs. 113, 114, 145-148, 181, 194, 218-220)

Specimens examined

The study was based on 25 pupae and 20 exuviae which were reared in the laboratory from adults collected in Saginaw Co., Michigan, on 5 August 1971 by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This species differs from *Coccinella trifasciata* by the hind wing apex being spinulated only along the ventrolateral margin (Figs. 181, 182). It can be separated from *Coccinella novemnotata* by the presence of tergal spots on abdominal segment 1, and by the median spot on the elytron at the basal one-third always being twice as wide as long (in *C. novemnotata* it is subquadrate). In addition, in dark forms, the elytron is dark brown or black over three-fourths of the surface, whereas in *C. novemnotata*, the dark area never reaches three-fourths of the elytral surface.

Description

Length: 6.5-8mm; width: 4.5-5mm. Body slightly elongate oval, yellowish, with well-defined, dark brown spots on dorsum and finely setiferous.

Head dark brown, with frontal area usually pale yellowish. In dark forms, the head is completely black except for one pair of circular yellowish spots on the frons. Mediolongitudinal pale whitish line always present. Eyes and antennae dark brown. Clypeolabrum dark brown except for mediolongitudinal pale line. Labral apex narrowed, with apical margin concave or sinuate concave. Surface of labrum deeply rugose, with deep longitudinal and subparallel wrinkles. Mandibles subequally bifid at apex.

Pronotum pale yellowish, in most cases with one pair of medio-apical subquadrate spots and two pairs of large claw-like spots, (one at anterior and one at posterior angles) (Fig. 113). In dark forms all of these spots may fuse together except medially, thus framing the anterior and lateral areas of the pronotum in dark brown (Fig. 114). In addition, one pair of mediobasal spots may be present, and one pair of very light brown, rectangular discal spots may also be present in some forms (Fig. 114). Meso- and metanotum yellowish to brown, each with one pair of distinct large spots. Elytron varies from very light to very dark. In most cases, elytral suture, lateral margin, and apex light to dark brown. In light forms, a median subrectangular spot (twice as wide

as long) at basal 1/3 is always present, a subcircular median spot at basal 2/3 is present in most cases, and these two spots occasionally narrowly fuse (Fig. 147). A subscutellar triangular spot is also very frequently present (Figs. 146, 147). In dark forms, the elytron is excessively black or dark brown except for the yellowish subhumeral and basal areas and a narrow yellowish stripe extending from the suturo-apical angle to the posterior end of lateral margin. The apex of hind wing slightly sclerotized and finely spinulated along the ventrolateral side (the length of this spinulated area is one-half as long the lateroapical margin of the elytron). In light forms, at least one pair of dark brown or black spots is present on each abdominal tergum except that terga 7 to 9 are usually immaculate. The small spots on terga 1 and 2 are subcircular and oval respectively. The spots on terga 4 to 6 are large, subquadrate, or subrectangular. Tergum 3 usually has 2 pairs of large dorsal spots and 2 pairs of large spiracular spots, with the anterior margin of the spots deeply sinuate. Abdominal pleura usually immaculate and yellowish, except for the third which is almost entirely dark brown. In dark forms, all abdominal terga are brownish to dark brown with yellow spots, except that the 1st tergum is yellowish with two subcircular dorsal brown spots, and the 9th tergum is pale and immaculate. Terga 2 and 3 each with a median keyhole-like yellow spot. Terga 4 to 7 each with one pair of spiracular yellow spots diminishing in size from 4 to 7, and with a median vase-shaped yellowish spot. Tergum 8 brownish and immaculate.

Abdominal pleura dark brown with a yellow spot on each, except that pleuron 1 is pale whitish, pleuron 2 brownish, pleuron 3 completely dark brown, pleuron 4 entirely yellowish and pleura 8 and 9 pale to very light brown.

Coccinella novemnotata Herbst
(Figs. 1, 2, 8, 35, 52, 70, 71, 149-151)

Specimens examined

The study was based on 18 pupae and two pupal exuviae which were reared from adults collected at the Gull Lake Biological Station, Kalamazoo Co., Michigan, on 20 May 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This species is very similar to *Coccinella transversoguttata* except that the tergal spots are absent on abdominal segment 1. On the elytron, the median spot at the basal one-third is subquadrate, whereas in *C. transversoguttata* it is subrectangular, twice as wide as long. In dark forms, the dark area of the elytron never reaches three-fourths of the surface, but does so in *C. transversoguttata.*

Description

Length: 6-7mm; width: 4-5mm. In general, very similar to *Coccinella transversoguttata.*

Head dark brown with two yellowish rounded spots which are medially fused on the frons. Labrum strongly convex dorsally, with longitudinal subparallel wrinkles

usually shallower than those of the clypeus. In a few cases, the surface of the labrum is smooth without such wrinkles. In most cases, anterior marginal spots of pronotum fused to each other except in the median area, and the posterior angular spot may join the apical angular spot along the lateral margin. Meso- and metanotum yellowish, with one pair of small circular and one pair of large oval spots on each. Elytron always dark brown along sutural area, lateral margin, and laterapical angle. In light forms, at least two median spots are present on each elytron . . . a large subrectangular spot on the basal two-fifths, and a small and elongate longitudinal spot parallel to the sutural margin at the basal three-fifths. These two spots are often fused together (Figs. 149-150). In dark forms, these median spots are completely fused with the dark sutural area, but this dark area never exceeds three-fourths of the elytral surface. Both the subscutellar and humeral dark area are tapered and pointed but without a well-defined border. The border is well-defined in *C. septempunctata.* First abdominal tergum immaculate. Urogomphi brownish or darker than abdominal sterna.

Coccinella monticola Mulsant
(Figs. 115, 116, 152, 182)

Specimens examined

The study was based on 11 dry pupae loaned from the U.S. National Museum, collected and identified by Dimmock.

Diagnosis

This species is very similar to *Coccinella transversoguttata* and *C. novemnotata* but the spinulated area on the hind wing apex appears shorter than one-half the length of the lateroapical side of the elytron. In *C. transversoguttata* and *C. novemnotata* it is as long as the length of the lateroapical side of the elytron.

Description

Length: 5.5-6mm; width: 3.5-4mm. Head completely dark brown without frontal yellow spots except the mediolongitudinal yellow line running the head length; surface deeply rugose.

Pronotum in most cases brownish, except apical and lateral margins are dark brown, with one circular sublateral and one elongate oval dorsal yellowish spot. These two spots may fuse medially in some forms (Figs. 115, 116). The longitudinal median pale line clearly present. Meso- and metanotum brownish except for elevated and pale scutellar area. Elytron as in dark forms of *Coccinella transversoguttata,* but lacking the yellowish stripe extending from suturoapical angle to distal end of lateral margin (Fig. 152). The spinulated surface along ventrolateral margin of hind wing apex shorter than one half of elytral apex. All legs are brown or brownish at coxae, femorotibial joints and tarsi.

Abdomen also as in dark forms of *Coccinella transversoguttata* except that median yellowish spots on abdominal terga 4 to 7 are large-mouthed-vase-shaped.

Coccinella septempunctata Linnaeus
(Figs. 143, 144)

Specimens examined

The study was based on 3 pupae from the U.S. National Museum collected in Denmark on 19 July 1893 by E. Rosenbero.

Diagnosis

This is the only species examined with subequal and well-defined oval spots on the elytron in light forms. In dark forms the elytral spot pattern is somewhat similar to the dark forms of *Coccinella novemnotata*; however, the humeral and scutellar ends of the dark area appear rounded or truncated with a well-defined contour. In *C. novemnotata* the above areas are poorly defined and usually tapered and pointed.

Description

Length: 6mm; width: 4mm. Head as *C. transversoguttata*, but more rugose and usually entirely dark brown.

Pronotum usually pale along lateral margins. Circular spot on mesonotum large, about one-half as large as that on metanotum.

Elytron usually brown along sutural margin, lateroapical angle and part of the lateral margin. In light forms, three well-defined subequal oval spots (much smaller than metanotal spots) are present. The subscutellar spot and the mediosutural spot at the basal two-fifths may be more or less fused with the dark sutural area. The lateral spot at the distal end of the lateral margin is free. Sometimes a humeral spot may be present, but it is often fused with the lateral marginal dark area (Fig. 143). In dark forms, the spots are not so distinct, but they are slightly darker than the surrounding areas. This dark form is very similar to the dark forms of *Coccinella novemnotata,* but the scutellar and humeral ends of the dark area are rounded or somewhat truncated with a well-defined contour (Fig. 144) in *C. septempunctata.*

Genus ADALIA Mulsant

Adalia bipunctata (Linnaeus)
(Figs. 36, 37, 82, 91, 117-119, 179, 180, 192)

Specimens examined

The study was based on 12 pupae which were reared from adults collected in Kalamazoo Co., Michigan, 8 April 1972 by Dang T. Phuoc. The specimens studied are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This genus is very similar to *Coccinella.* As previously mentioned these are the only 2 genera of Coccinellidae examined which have the hind wing apex finely spinulated.

Adalia is separated by the presence of spinules on the dorsal and ventral surface of the hind wing apex, whereas in *Coccinella* the hind wing apex is spinulated on the ventral surface only.

Description

Length: 4.5-5mm; width: 3.5-4mm. Body slightly elongate oval, convex dorsally, yellowish with large dark brown spots on dorsal surface and finely setiferous.

Head light to dark brown, nearly smooth but with a few wrinkles. Mediolongitudinal pale line always present. Eyes dark brown. Antennae long, extending over half the distance between the widest lateral margin of the pronotum and the eye; club subspherical with three rings of well developed papillae, the third ring incomplete by lacking some dorsal papillae; flagellum subquadrate in cross section; scape flat, subtriangular and slightly expanded caudally. Clypeolabrum hexagonal (Figs. 36, 37), slightly rugose with longitudinal wrinkles visible but shallow. Clypeus narrow at base. Labrum tapered apically and with apical margin deeply concave (Fig. 37). Maxillary palpi large, trapezoidal, with outer lateral margin convex (Fig. 36). Surface of galea armed with a few fine teeth at anterior inner angle (Fig. 82). Labial palpus rugose and short.

Pronotum immarginate to slightly marginate along apical margin; surface rugose and irregularly brownish to dark brown. In most cases the apical and posterior angles, mediobasal area and mediolongitudinal line are pale yellowish. Prothoracic spiracles rounded (Fig. 193). Mesonotum brownish to dark brown with two subtriangular pale spots at posterior angles. Scutellar area elevated in the middle with a triangular pale spot. Mediolongitudinal line pale and greatly enlarged anteriorly. Apical angles of mesonotum elevated. Metanotum slightly elevated along median line, with two large dorsal dark brown spots fused together in some cases and occupying most of the surface.

Elytron immaculate dark brown at median and sutural area, then gradually lighter toward apex and lateral margin. A median light brown, poorly defined spot may be present in some forms at about basal two-fifths. Lateral margin usually pale yellowish or light brown. Hind wing apex brownish, slightly sclerotized, finely and densely spinulated along ventrosutural and *both* ventro- and dorsolateral margins (Figs. 179-180). Legs short, brownish except for pale yellowish femoral bases and tibiotarsal joints. Surface of the leg slightly rugose with a few transverse wrinkles.

Abdomen as in *Coccinella,* but slightly darker, each abdominal tergum with one pair of small subquadrate spiracular and one pair of large subrectangular dorsal dark brown spots. Spots on the first tergum greatly reduced in size; tergum eight brownish and immaculate. Abdominal pleura brownish with pale yellowish margins except for pleura 8 and 9 which are completely pale. Urogomphi as in *Coccinella.*

Genus CYCLONEDA Crotch

Diagnosis

This genus is representative of the remaining species of Coccinellini which possess a smooth hind wing apex. *Cycloneda* shows the closest affinity to *Mulsantina* Weise; however, *Cycloneda* can be separated by the subspherical antennal club (Fig. 38), and

the subacute apical angle of the clypeolabrum (Fig. 38). In *Mulsantina* the antennal club appears cylindrical or subrectangular block-shaped (Fig. 53), and the apical angle of the clypeolabrum is rounded (Fig. 33).

Description

Length: 4.5-5mm; width: 3-3.5mm. Body slightly elongate oval and finely setiferous.

Head entirely brown with mediolongitudinal line or frontal area pale; surface smooth to very slightly rugose. Eyes brownish. Antennae (Fig. 38) brown and long, extending over two-thirds of the distance between the widest lateral margin of the pronotum and the eye; club subspherical and distinct with four rings of well-developed papillae; flagellum subquadrate in cross section; scape somewhat flat, subtriangular and with upper surface slightly rugose. Clypeolabrum subquadrate, slightly narrowed apically and with the apical margin concave. Apical angles of labrum subacute (Fig. 38). Mandible bifid at tip. Maxillary palpus brown, large, trapezoidal or lanceolate. Galeal surface armed with several fine teeth, but less than five at the anterior inner angle. Labial palpus short and rounded, brown and slightly rugose at tip.

Pronotum pale yellowish, usually with dark brown spots along anterior and posterior margins. Lateral margin and especially the anterior margin strongly marginate (Fig. 39). Prothoracic spiracle elongate oval. Meso- and metanotum pale, slightly rugose and sometimes maculate. Elytron immaculate, brown to dark brown along sutural margin from base to about the basal three-fourths, and gradually lighter toward lateral margin. Apical, subapical, basal and subbasal areas pale yellowish. Elytral surface finely setiferous and densely micronodulated (as in Fig. 7). Epipleura wide and slightly concave. Hind wing slightly sclerotized at apex, surface smooth. Legs light brown except femoral bases and distal ends of tibia which are pale.

Abdominal terga whitish or yellowish, with dorsal dark brown spots. Posterior margin of terga 3 to 6 finely dentulated. Abdominal spiracles circular or nearly so. Abdominal pleura subquadrate and slightly rugose. Abdominal sterna pale immaculate. In the ♀, abdominal sternum 9 is bimammillate and well sclerotized at the tip.

Key to Species of the Available Pupae of *Cycloneda*

1 Setae with conspicuous cuticular ring; pronotum with 2 pairs of anterior and 2 pairs of basal subquadrate dark brown spots; mesonotum with one pair of large subcircular spots ..... *Cycloneda munda* (Say)

1' Setae with inconspicuous cuticular ring; anterior and basal spots on pronotum greatly reduced or wanting; mesonotum usually immaculate ..... *Cycloneda sanguinea* (Linnaeus)

Cycloneda munda (Say)
(Figs. 38, 39, 81)

Specimens examined

The study was based on 11 pupae which were reared from adults collected in Kalamazoo Co., Michigan, 24 May 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

Cycloneda munda may be easily separated from *C. sanguinea* by the conspicuous, well sclerotized cuticular ring surrounding the base of each seta, and the mesonotum usually having one pair of dark brown spots. In *C. sanguinea* the cuticular ring surrounding the base of the setae is obsolete and the mesonotum is usually immaculate.

Description

Length: 4.5-5mm; width; 3-3.5mm. Body slightly elongate oval and finely setiferous, but the setae with very conspicuous and well sclerotized cuticular rings.

Head light yellow except eyes, antennae and maxillary palpi brownish.

Pronotum pale light yellow with two pairs of apical and two pairs of basal subquadrate spots. Meso- and metanotum pale yellowish, each with one pair of large subcircular dark brown spots. Elytron dark brown along sutural area and gradually lighter toward lateral margin; basal, subbasal, apical and subapical areas light yellow.

Dorsal surface of abdomen light yellow, abdominal terga 1, 8, and 9 immaculate. The rest of the terga each have at least one pair of dorsal dark brown spots, except the second and third which have an additional pair of spiracular spots.

Abdominal pleura light yellow and immaculate, but the third one dark brown except for the margins.

Cycloneda sanguinea (Linnaeus)

Specimens examined

The study was based on 30 pupae from the U.S. National Museum collected in Florida on May 1875 and on 31 March 1971.

Description

Similar to *Cycloneda munda* except that the head is entirely brown except for the mediolongitudinal pale line, and the pronotum is yellow, with the marginal spots greatly reduced or wanting. Mesonotum usually pale and immaculate or with very small spots. Setae with inconspicuous cuticular rings.

Genus MULSANTINA Weise

Mulsantina picta (Randall)
(Figs. 33, 53, 80, 122, 139)

Specimens examined

The study was based on 12 pupae which were reared in the laboratory from adults collected in Clinton Co., Michigan, 30 May 1971, by Dang T. Phuoc. All specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

As mentioned before, this species is very closely related to *Cycloneda* (see *Cycloneda* diagnosis for separation of these 2 genera). *Adalia, Coccinella, Cycloneda, Mulsantina* and *Propylaea* represent a group of species of Coccinellini without a mesal process at basal one-third of the urogomphus. *Mulsantina* differs from *Propylaea* by having very fine and normal setae, whereas in *Propylaea* the setae appear more coarse and are borne on a small tubercle (chalaza) with the distal end strongly curved. See *Adalia* and *Coccinella* for the diagnostic characters of these two genera.

Description

Length: 6mm; width: 3.5mm. Body elongate oval, extremely pale yellowish and finely setiferous.

Head mostly pale and very smooth. Eyes brown, much darker than face. Antennae long, extending about two-thirds of the distance between the widest lateral margin of the pronotum and the eyes. Antennae dark brown on upper surface; club distinctly cylindrical elongate or subrectangular block-shaped with 4 rings of papillae; flagellum long and subquadrate in cross section; scape somewhat rectangular and slightly convex (Fig. 53). Clypeolabrum smooth and pale, slightly wider than long, with lateral margins subparallel. Apical margin concave and apical angles rounded (Fig. 33). Mandibles bifid at apex and with molar surface well sclerotized. Maxillary palpi trapezoidal, glabrous, slightly rugose and brownish, usually darker along lateral sides; surface of the galea armed with more than 5 very fine but conspicuous teeth (Fig. 80).

Pronotum deeply marginate along apical margin, surface slightly rugose, mostly pale and finely setiferous. In dark forms, the pronotum usually with 2 pairs of apical spots (the inner larger and suboval), and 2 pairs of basal spots (the inner also much larger than the outer and comma-shaped) (Fig. 122). Prothoracic spiracle elongate oval. In most cases, mesonotum entirely pale except for very light brown or brown margins. In dark forms, the mesonotum is light brown, with the anterior angles and lateral sides of scutellar area brown. Metanotum pale in all cases, usually with one pair of large boot-shaped spots (Fig. 139). Elytron pale or light brown, surface micronodulate (as in Fig. 7). Sutural margin dark, and epipleura pale, wide and slightly concave. Hind wing membranous, inconspicuously micronodulate along mid-ventrolateral margin but never on apex. Legs dark brown at femorotibial joints and tarsi; surface of femorotibial joints micronodulate.

Abdominal terga pale and maculate, usually with two pairs of subquadrate spots on each (one pair spiracular and one pair dorsal) except the 1st, 8th and 9th which are completely pale and immaculate, and the 6th and 7th which lack subspiracular spots. In light forms, the spiracular spots are greatly reduced in size, and the posterior margin of terga 3 to 5 is finely dentulate. Abdominal spiracles circular or nearly so, with the first 5 well sclerotized. Urogomphi with base simple and slightly darker than abdominal sterna. Abdominal pleura subquadrate, pale and immaculate except for the 3rd which has a light brown spot. Ventral surface of abdomen completely pale and immaculate.

Mulsantina hudsonica (Casey)
(Figs. 123, 140)

Specimens examined

The study was based on 4 pupae and an exuvia collected in Chippewa Co., Michigan, 19 June 1972, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Description and diagnosis

This species is very similar to dark forms of *Mulsantina picta,* except that the mesonotum is mostly brownish and the metanotal spots are large and subquadrate (Fig. 140). Length: 5.5mm; width: 3-5mm. Hind wing apex micronodulated.

Genus OLLA Casey

Olla abdominalis (Say)
(Figs. 34, 138, 225, 226, 245)

Specimens examined

The study was based on a single pupa from the U.S. National Museum collected in Folsom, California, July 1885, and 8 pupae collected in Gainsville, Florida, on 26 July 1972 by R. E. Waites. Two of the Florida specimens are deposited in the Entomology Museum at Michigan State University, the remainder have been returned to Dr. Waites, Department of Entomology and Nematology, University of Florida.

Diagnosis

This is the only species of Coccinellini examined which has the body rounded and strongly convex dorsally, with the dorsum apparently glabrous and pale yellowish or silky white with well-defined dark brown rounded spots. Other members of the tribe usually have a slightly elongate oval body and are finely setiferous. The strongly convex antennal scape, giving sharp separation between the scape and the flagellum, and the presence of a mesal process on the urogomphus (Figs. 225, 226) separates this species from *Cycloneda* and *Mulsantina* whose antennal scape appears flat or very slightly convex anteriorly, and whose urogomphus is without such a mesal process.

Furthermore, *Olla* can be separated from *Neoharmonia* by the mesal process appearing short and blunt, and the dorsum being smoother. In *Neoharmonia* the mesal process of the urogomphi is slender and more pointed, and the dorsum is rugose and punctate.

Description

Length: 4mm; width: 3.5mm. Body rounded and convex dorsally, yellowish or silky white, with light brown to dark brown and well defined rounded spots on dorsal surface, and very finely and sparsely setiferous.

Head yellowish to light brown, surface smooth and somewhat shiny. Eyes brownish. Antenna yellowish to brown, and extending over two-thirds of the distance between the widest lateral margin of the pronotum and the eye. Antennal club subspherical and distinct, with three rings of papillae, the last ring incomplete by lacking some of the anterior papillae. Flagellum subquadrate in cross section. Scape strongly convex anteriorly and expanded caudally. Clypeolabrum gradually narrowed and slightly to deeply concave at apical margin (Fig. 34). Mandibles bifid at apex. Maxillary palpi large, brownish and trapezoidal; surface slightly rugose, galeal surface smooth and pale.

Pronotum basically yellowish, strongly marginate along lateral and especially along anterior margin (Fig. 138). Marginal areas brownish, with one pair of small, rounded, dark brown anterodiscal spots and 2 pairs of rounded or subquadrate outer and inner basal spots which are three times as large as the anterodiscal spot (Fig. 138). Prothoracic spiracle pale and elongate oval. Meso- and metanotum silky white, rugose with one pair of subcircular well-defined dark brown to black spots on each. Elytron yellowish at base and apex with three large brown longitudinal sutural, median and lateral stripes extending from base to the apical one-third (Fig. 245). The median stripe may be broken at the basal one-third to give a subbasal oval or rounded spot (Fig. 245). The pupa from the U.S. National Museum has the elytron entirely pale yellowish (probably faded). Epipleura wide and concave, with lateral angle slightly expanded anteriorly, and elytral surface densely micronodulate.

Hind wings slightly sclerotized at apex, surface smooth. Legs short and pale except femorotibial joints and tarsi yellowish or light brown.

Abdominal terga silky white, each with one pair of dorsal and one pair of spiracular, well-defined, dark brown spots about one-third as big as the metanotal spots, except that terga 1, 8 and 9 are immaculate, and the dorsal spots on tergum 2 are absent. Urogomphi slightly branched mesally at about basal one-third into a short and dull spine-like process; urogomphal disk with inner lobe elongate oval and small, one-fourth as large as the outer one (Fig. 226). Abdominal pleura subquadrate and yellowish, with posteriolateral angle slightly expanded caudally. Each pleuron with a rounded brown spot but getting gradually lighter and disappearing in pleura 6 to 9. First two pleura entirely pale and immaculate. Abdominal sterna immaculate and yellowish.

Genus PROPYLAEA Mulsant

Propylaea quatuordecimpunctata (Linnaeus)
(Figs. 44, 56, 172)

Specimens examined

The study was based on 4 pupae of *Propylaea quatuordecimpunctata* which were reared in the laboratory from adults given by Dr. R. D. Eikenbary of Oklahoma State University. The specimens are deposited in the Entomology Museum of Michigan State University and the U.S. National Museum.

Diagnosis

This is the only known species of Coccinellini with very long antennae with a C-shaped flagellum and with the tip partly hidden under the front femur. In addition only abdominal terga 5 to 7 are "detachable" from their margins, whereas all other members of the Coccinellini have terga 4 to 7 movable. Furthermore, *Propylaea* shows some degree of close affinity to *Anisocalvia* by the presence of chalaza-type setae on both forms. However, *Propylaea* can be separated from *Anisocalvia* by the lack of lateral processes on abdominal pleura 3 to 5, and by the characteristic, long, C-shaped antennae.

Description

Length: 5mm; width: 4mm. Body oval, slightly elongate, light brown, with poorly defined dark brown spots on dorsal surface. Body somewhat coarsely and densely setiferous, and bearing chalaza-type setae whose tips strongly curve to the body surface.

Head entirely pale and smooth. Eyes light brown. Antennae (Figs. 44, 56) light brown, very long, and if straight, extending considerably beyond the widest lateral margin of the pronotum. Antennae actually with six rings of papillae, the first two rings complete with well developed papillae, but the last four incomplete, with dorsal and anterior papillae wanting, or greatly reduced in size, especially in the sixth. Antennal club not so distinct, with the diameter subequal to that of the flagellum and hidden under the front femur. Flagellum long, "C"-shaped and subquadrate in cross section, with the proximal end somewhat flattened and slightly notched at lower side. Scape oval and distinct. Clypeolabrum smooth and subquadrate, with the apex abruptly narrowed apically and with the apical margin slightly concave (Fig. 44). Mandibles bifid at tip. Maxillary palpi large, trapezoidal and light brown at the apex. Galea with upper inner surface armed with several very fine teeth. Labial palpi rounded, smooth and light brown at tip.

Pronotum deeply marginate apically, usually pale at apical angles, dark brown along the posterior margin, and gradually lighter toward apical margin. Mediolongitudinal line pale. Prothoracic spiracles elongate oval. Mesonotum light brown, scutellar area slightly elevated and pale. Metanotum pale with two large, poorly defined, dark brown spots. Elytron with lateroapical angle obtuse and rounded, and with a large, irregular, brown, transverse band extending from sutural

area to the lateral margin at the basal one-fifth to three-fifths, and becoming gradually lighter along the sutural area toward the base and apex. Epipleura wide and slightly concave. Legs pale, except light brown at coxae, femorotibial joints and tarsi.

Abdominal terga yellowish, immaculate, except terga 3 and 4 each with one pair of large subquadrate spiracular spots which are considerably lighter or absent on the fifth or sixth terga. On the whole, the maculation is usually not well-defined.

Urogomphi straight along inner lateral margins and as dark as the previous tergum. Abdominal spiracles circular or nearly so and very slightly sclerotized. Abdominal pleura subquadrate, immaculate, light yellow to light brown, with pleura 3, 4, and 5 very coarsely and densely setiferous along the lateral margins (Fig. 172). Abdominal sterna immaculate and pale. In the ♀, abdominal sternum 9 is bipartite and mammillate, and in the ♂ sternum 9 is rectangular, flat or very slightly convex.

Genus NEOHARMONIA Casey

Neoharmonia venusta (Melsheimer)
(Figs. 40, 111, 171, 222)

Specimens examined

The study was based on a single pupal exuvia of *Neoharmonia venusta* from U.S. National Museum, collected in Brownsville, Texas, 18 April 1944 by Callaghan.

Diagnosis

This species is representative of a group of species of Coccinellini (including *Anatis, Ansocalvia* and *Synonycha*) which possess a mesal process at about the basal one-third of the urogomphus (Fig. 222). However, the lack of a lateral process on abdominal pleura 3 to 5 separates this species from the others.

Description

Length: 5-7mm; width: 4-5mm. Body slightly elongate and finely setiferous.

Head light brown. Eyes brownish. Antennae long, extending about two-thirds the distance between the widest lateral margin of the pronotum and the eye. Antennal club subspherical, with three rings of distinct and well-developed papillae, the dorsal papillae of the third ring lacking. Flagellum subquadrate in cross section. Scape somewhat flat and slightly expanded caudad. Clypeolabrum smooth, gradually narrowed and slightly concave at apex, with rounded apical angles (Fig. 40). Maxillary palpus large and trapezoidal, with outer lateral side slightly convex.

Pronotum rugose and deeply marginate along lateral and especially along the anterior margin, with two pairs of large oval brown spots at the base and one pair of large anterior spots (Fig. 111). Mesonotum rugose and dark brown. Metanotum yellowish with two large subquadrate dark brown spots. Elytron finely setiferous and immaculate, brownish, with basal marginal area pale. Epipleura wide, slightly concave, and with the lateral angle of the elytron slightly expanded anteriorly.

Abdominal terga slightly rugose and punctate, yellowish to brownish, and with poorly defined dark brown spots. Each tergum usually with one pair of dorsal and one

pair of spiracular spots, except that tergum 1 is pale and immaculate. Abdominal spiracles circular, the first five well-sclerotized. Urogomphus branching mesally into a long and slender spine-like process at basal one-fourth (Fig. 222). Abdominal pleura yellowish or brownish, usually paler along marginal areas. Pleura 3 to 6 large, subquadrate, with the posterior lateral angles slightly expanded caudad and deeply rugose and punctate (Fig. 171). Sternum 9 bipartite and mammillate in the ♀.

Genus ANATIS Mulsant

Diagnosis

This genus is representative of a group of three genera of Coccinellini (*Anatis, Anisocalvia* and *Synonycha*) which have a lateral process on abdominal pleura 3 to 5 (Fig. 178). *Anatis* differs from *Anisocalvia* by the body being much larger with more well-defined spots on the dorsum, and by having the apical margin of the labrum slightly sinuate (Fig. 32). *Anatis* differs from *Synonycha* by the pleural process being much shorter (equal to or shorter than the corresponding pleuron).

Description

Length: 7-10mm, width: 5.5-6mm. Body light yellow with well-defined dark brown spots on dorsal side and finely setiferous.

Head dark brown, smooth except median line pale. Eyes brownish. Antennae long, extending to the lateral margin of the pronotum. Club not distinct, with the diameter of the club subequal to that of the flagellum. Flagellum long and subquadrate in cross section. Scape somewhat flat and slightly convex along lower margin. Antenna actually with 6 rings of papillae, the apical 4 rings with well developed papillae and occupying the "club" of the antenna, the fifth and the sixth rings located on the flagellum, with the papillae greatly reduced in size or flattened (Fig. 54). Clypeolabrum gradually narrowed apically, with the apical margin slightly sinuate, surface slightly rugose with a few shallow wrinkles (Fig. 32). Mandibles bifid. Maxillary palpus smooth, large and trapezoidal, with lateral margins parallel (Fig. 32). Surface of galea armed with several fine teeth, especially on the anterior inner angle (Fig. 79). Labial palpi slightly rugose at tip, and one pair of fine teeth may be present on the ligula (Fig. 98).

Pronotum pale and strongly marginate along lateral and anterior margins, with dark brown spots along antero- and basomarginal areas; lateromarginal areas always pale (Figs. 120-121). Prothoracic spiracle elongate oval. Mesonotum with scutellar area elevated and usually with one pair of rounded spots anterior to the "scutellum." Metanotum slightly elevated along mediolongitudinal line with one large pair of subquadrate spots. Elytron pale yellowish, maculate and finely setiferous. Epipleura wide and concave; lateroapical angle obtuse and almost continuous with lateral margin. Legs light brown except femoral bases and tibiotarsal joints. Tibial papillae obtuse.

Posterior margins of abdominal terga 4 to 6 smooth. Urogomphi branched mesally at basal one-third into a long spine-like process. Abdominal spiracles circular or nearly so and slightly sclerotized. Abdominal pleura 3 to 5 large and with a spine-like process on each which projects laterocaudad from posteriolateral angle (Fig. 178). Abdominal sterna pale and immaculate, with the first 2 hidden under the metacoxae, but visible and distinct medially. The third sternum the largest, with anterior margin deeply sinuate. In the ♀, abdominal sternum 9 bipartite and mammillate, and more homogeneously and more strongly sclerotized than the previous sterna, whereas in the ♂, sternum 9 remains flat and subrectangular.

Key to Species of the Available Pupae of *Anatis*

1 Elytral apex pale (Fig. 153); lateral margin of pronotum brown or light brown at posterior end (Fig. 120); first abdominal tergum maculate ..... *Anatis ocellata* (Linnaeus)

1' Elytral apex brown (Fig. 154); lateral margin of pronotum entirely pale (Fig. 121); first abdominal tergum immaculate ..... *Anatis quindecimpunctata* Olivier

Anatis ocellata (Linnaeus)
(Figs. 32, 54, 79, 90, 98, 120, 153, 178, 224)

Specimens examined

The study was based on 14 pupae which were reared in the laboratory from adults collected in Rose Lake Wildlife Experiment Station, Clinton Co., Michigan, 25 May 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and the U.S. National Museum.

Diagnosis

Two species of *Anatis* are known as pupae. They can be separated from one another by the elytral apex being brownish and the first abdominal tergum maculate in *A. quindecimpunctata,* whereas in *A. ocellata* the elytral apex appears pale and the first abdominal tergum is immaculate.

Description

Length: 7-10mm, average 9mm; width: 5.5-6mm. Head brown except frontal area pale; surface smooth except clypeolabral area slightly rugose.

Pronotum (Fig. 120) with two pairs of subquadrate spots along apical margin, one pair of extremely elongate oval spots at base and two large "L"-shaped spots at posterior angles. Mesonotum brown at anterior angles and along lateral margins, and with one pair of small circular spots located anterior to the scutellar area. Metanotum with one pair of large subquadrate spots. Elytron pale yellowish and maculate (Fig.

153), with sutural marginal area dark brown except for the subapical portion. Epipleura pale with a large subquadrate subbasal spot and a lighter distal spot. Elytral surface with three large circular spots (consisting of a humeral and two sublateral at basal two-fifths and three-fifths respectively), and with two mediosutural, elongate oval, large spots at basal one-third and two-thirds respectively. Basal area of elytron light brown.

Each abdominal tergum usually with one pair of large spiracular subquadrate spots and one pair of large subrectangular dorsal spots except tergum 1 where spiracular spots are absent. Terga 7, 8 and 9 immaculate. All abdominal pleura immaculate and yellowish, but pleuron 2 with a small light brown spot and pleuron 3 with a large subquadrate spot. Mesal spine-like process at basal one-third of urogomphus short and obtuse (Fig. 224).

Anatis quindecimpunctata Olivier
(Figs. 121, 154, 223)

Specimens examined

The study was based on 4 pupae which were reared in the laboratory from adults collected in Rose Lake Wildlife Experiment Station, Clinton Co., Michigan, on 24 May 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Description

Length: 7-10mm; width: 5-6mm. Similar to *Anatis ocellata,* but maculation slightly different. Lateral margin of the pronotum entirely pale, with the spot at posterior angle subtriangular (never "L"-shaped or claw-like). Lateral sides and anterior angles of mesonotum pale. Elytral apex and in some cases epipleura entirely light brown (Fig. 154); basal area pale. First abdominal tergum entirely pale, spots greatly reduced in size, and spiracular spots on terga 5 and 6 also reduced in size or wanting. Mesal spine-like process at base of urogomphus long and slender with apex somewhat pointed (Fig. 223).

Genus ANISOCALVIA Crotch

Anisocalvia quatuordecimguttata (Linnaeus)
(Figs. 45, 177, 221)

Specimens examined

The study was based on one pupa and one exuvia saved from an emerged adult in Chippewa Co., near Tahquamenon State Park, Michigan, 18 June 1972 by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University.

Diagnosis

This genus is very closely related to *Anatis,* with a lateral spine-like process at posteriolateral angle of abdominal pleura 3 to 5, and long antennae. However, the size is considerably smaller than *Anatis,* about 5mm in length, the apical margin of clypeolabrum is deeply concave, and the pleurolateral process is conical and densely setiferous with chalaza-type setae which are strongly curved distally (Fig. 177).

Description

Very similar to *Anatis* in many respects except for the following:

Length: 5mm; width: 3.5mm. Head brownish along marginal areas, including eyes, antennae and maxillary palpi. Clypeolabrum subtrapezoidal, with apical margin deeply concave and apical angles subpointed (Fig. 45).

Spot pattern on dorsal surface of the body very similar to *Anatis ocellata,* except that here the spots are very large, almost filling the segment, and are usually subquadrate or subrectangular and not as well defined, especially those on the abdomen. Elytron light brownish, with 2 large longitudinal brown bands extending from base to about basal one-half, the sutural band appearing much darker than the sublateral band. Pleurolateral process on abdominal segments 3 to 5 conical and densely setiferous, with chalaza-type setae which are strongly curved distally (Fig. 177). Posteriolateral angle of pleuron 6 angulate and densely setiferous.

Genus SYNONYCHA Mulsant

Synonycha grandis (Thunberg)
(Figs. 51, 176)

Specimens examined

The study was based on two broken pupal exuviae of *Synonycha grandis* from U.S. National Museum, collected in Buitenzog, Java, by Bryant and Palmer.

Diagnosis

This genus can be quite easily distinguished from *Anatis* and *Anisocalvia* by the short antenna which extends about half way between the widest lateral margin of the pronotum and the eye, by the presence of only 4 rings of papillae, and by the pleurolateral spinelike process of abdominal segments 4 to 6 being cylindrical and slightly curved cephalad, with the length exceeding the greatest width of the corresponding pleuron.

Description

Length: over 10mm (10-12mm); width: 6-8mm. Body larger than *Anatis*. Head entirely brown, smooth, except for clypeolabrum and genae which are slightly rugose. Antennae short, extending about half way between the lateral margin of the pronotum and the eye. Antennae with four rings of papillae. Flagellum short and subtriangular in cross section. Scape greatly expanded and somewhat flattened (Fig. 55). Clypeolabrum large with apical margin convex. Mandibles bifid at apex.

Maxillary palpi smooth, with outer lateral margin slightly sinuate and very obtuse at apex. Surface of galea covered with a few very fine teeth. Labial palpi smooth.

Pronotum deeply marginate, especially along apical and lateral margins. At least one pair of large subquadrate spots at apical margin, one pair of subrectangular spots at posterior angles, and one pair of subquadrate spots at base. Prothoracic spiracle elongate oval. Meso- and metanotum pale, each with a pair of large brown spots. Elytron brown except for pale lateral margin, apex and sutural area. Epipleura light brown. Hind wing apex glabrous and smooth. Maculation on abdominal terga as in *Anatis ocellata,* except that the 1st tergum is immaculate. Urogomphi branched mesally at about basal one-third into a long spine-like process.

Abdominal spiracles circular or nearly so and slightly sclerotized. Abdominal pleura immaculate and pale, except the third and the fourth which have a large subquadrate spot. Pleural spine-like process longer than the greatest width of the corresponding pleuron, and projecting laterocephalad (Fig. 176). Ventral abdomen immaculate and pale.

Genus HIPPODAMIA Dejean

Diagnosis

This genus is representative of a group of genera of Coccinellini including *Coleomegilla, Naemia, Paranaemia* and *Eriopis* which possess long and slender legs, with the front femora considerably extended beyond the widest lateral margins of the pronotum. This character separates this group from the remaining species of the Coccinellini. *Hippodamia* in turn, is distinguished from other members of the group by the glabrous condition of the exposed intersegmental conjunctivae of abdominal segments 3 to 7 and by the lateral angle of the elytron which is greatly expanded anteriorly into a rounded distinct process (Figs. 164-170).

Description

Length: 4mm-6mm; width: 2.5mm-3.5mm. Body elongate oval, finely setiferous, bright yellow and distinctly maculate. Surface of the body and elytra densely micronodulated.

Head deeply rugose, dark brown, always with mediolongitudinal pale yellowish line running the length of the head. Bright yellow frontal spots sometimes present. Eyes brown. Antennae dark brown and long, extending to the widest lateral margins of the pronotum, with 4 rings of well developed papillae; club subspherical and distinct, with the diameter much larger than that of the flagellum which is subquadrate in cross section; scape strongly convex and expanded caudally (Fig. 47). Clypeolabrum deeply rugose and dark brown, slightly longer than wide, with apical margin concave to deeply cleft. Mandibles bifid at tip. Maxillary palpi large, lanceolate, dark brown and rugose. Labial palpi dark brown and smooth.

Pronotum bright yellow with dark brown spots along marginal areas (Figs. 128-137). Lateral margin strongly expanded into knife-like edge (Fig. 133). Mesonotum with rugose anterior angles and elevated scutellar area. Metanotum smooth, with 2 large dark brown spots. Elytron yellow with lateral and sutural areas, lateral angle

and apex brownish to dark brown. Elytron with a humeral spot and a mediosutural spot which are subequal, small, well defined and distinct; also with a large medial spot, three to four times as large as the humeral or mediosutural spot, and often fused with the sutural dark area. Lateral angle greatly expanded anteriorly into a prominent thumb-like rounded lobe (Figs. 158-159); lateral margin strongly marginate and the epipleura wide and slightly concave. Hind wing membranous, tapered apically and glabrous. Legs long, with front femora extending considerably beyond lateral margins of the pronotum (Figs. 41, 47), and dark brown except for femoral bases and distal ends of tibiae which are pale. Tarsi light brown.

Abdominal terga bright yellow with large dark brown spots. Dorsal tubercles well developed (Fig. 244). Posterior margins of terga 3 to 6 conspicuously spinulate. Exposed intersegmental conjunctivae of abdominal segments glabrous. Abdominal spiracles circular or nearly so, except the first which is elongate oval and partly hidden under the elytra. Abdominal pleura subquadrate. Abdominal sterna immaculate pale yellowish or brownish.

Key to Species of the Available Pupae of *Hippodamia*

1 Elytron with a subscutellar L-shaped spot
..... *Hippodamia quinquesignata* (Kirby)

1' Elytron without a subscutellar L-shaped spot 2

2(1') Clypeolabrum subquadrate with apical margin slightly concave and never notched (Figs. 47, 48); lateral angle of the elytron longer than wide (Fig. 159) ..... *Hippodamia parenthesis* (Say)

2' Clypeolabrum not quite subquadrate, with apical margin deeply notched (Fig. 41); lateral angle of the elytron as wide as long or slightly wider than long (Fig. 158) 3

3(2') Scutellar area of mesonotum at least dark brown at base; lateral margin of the pronotum brownish to dark brown (Figs. 136, 137) 4

3' Scutellar area of mesonotum always pale yellowish; lateral margin of the pronotum always pale yellowish (Figs. 128-130) ..... *Hippodamia tredecimpunctata* (Linnaeus)

4(3) Elytron with a subbasal transverse band extending from subsutural area to humeral angle (Figs. 166-168) ..... *Hippodamia quinquesignata* (Kirby)

4' Elytron without such a subbasal transverse band (Figs. 169-170) 5

5(4') Dorsal tubercles on abdominal segments very well developed, with the tip directed caudally as seen laterally (Fig. 244) ..... *Hippodamia convergens* Guerin

5' Dorsal tubercles on abdominal segments not as well developed, and slightly elevated above abdominal terga, the tip never directed caudally as seen laterally ..... *Hippodamia glacialis* (Fabricius)

Hippodamia tredecimpunctata (Linnaeus)
(Figs. 128-130, 160, 161)

Specimens examined

The study was based on 20 pupae reared in the laboratory from adults collected in East Lansing, Michigan, 21 August 1968, and eight pupae collected in East Lansing on 19 July 1972, by Dang T. Phuoc. The specimens are deposited in Entomology Museum at Michigan State University and the U.S. National Museum.

Diagnosis

This species, along with the other known species of *Hippodamia,* including *H. convergens, H. glacialis* and *H. quinquesignata,* can be separated from *H. parenthesis* by the apical margin of the clypeolabrum being deeply notched, by the apical angles being subpointed and strongly projected caudally, and by the lateral angle of the elytron being no longer than the base of the angle. In *H. parenthesis,* the clypeolabrum appears subquadrate, with the apical margin slightly concave or subtruncate, and never with the apical angles projected caudally. In addition, the lateral angle of the elytron appears longer than the basal width. *H. tredecimpunctata* in turn is separated from *H. convergens, H. glacialis* and *H. quinquesignata* by the always pale scutellar area of the mesonotum and the pale lateral margin of the pronotum . . . these areas of the last three species are brownish or dark brown.

Description

Length: 4.5mm-5mm; width: 2.5mm-3mm. Head rugose, dark brown except for mediolongitudinal pale yellowish line; frontal area may be pale. Antennae light to dark brown. Clypeolabrum slightly longer than wide, rugose with lateral margins subparallel but abruptly narrowed apically, the apical margin deeply notched with the apical angles projected caudally and pointed (as in Fig. 41).

Pronotum yellowish, rugose along anterior marginal area. In light forms there are two pairs of subcircular spots at the anterior and posterior angles (Fig. 128) while in dark forms the anterior and posterior spots are connected anteroposteriorly by a large longitudinal band into one pair of elongate, hourglass-shaped spots (Fig. 129). One pair of large subrectangular anterior spots, and one pair of small basal oval spots may be present. In some cases, all of these spots may be fused together; then the pronotum becomes black or dark brown with one pair of rounded, oval, lateral, yellow spots, and one large heart-shaped discodorsal yellow spot (Fig. 130). Mesonotum yellow with

brown anterior angles; scutellar area always pale yellowish even in very dark forms. Metanotum yellow with one pair of large oval or kidney-shaped lateral spots which are greatly enlarged in dark forms so they fill the metanotal surface except for the pale yellow mediodorsal area. Elytron, in light forms, with a humeral and mediosutural spot at the basal one-third, and a very large (as large as the other two spots combined) median spot at the basal one-half (Fig. 160). In dark forms the elytron is completely dark brown or black.

Each abdominal tergum usually with one pair of spiracular and one pair of dorsal subquadrate spots, except that tergum 1 is immaculate or with one pair of small dorsal oval spots, terga 8 and 9 are immaculate and pale, and tergum 4 lacks spiracular spots. Terga 2 and 3 are in some cases almost entirely dark brown due to the spiracular and dorsal spots being greatly enlarged and fused except for the median pale area. Abdominal pleura yellow and immaculate except that the exposed portions of pleura 2 and 3 are dark brown.

In dark forms, dorsum of abdomen almost entirely dark brown or black except for a median pale yellow spot which is light-bulb-shaped on segment 2, narrowly elongate subrectangular on segment 3, and large-mouthed-vase-shaped or subquadrate on segments 4 and 5. Terga 1, 7 and 8 yellow, each with one pair of subquadrate dorsal dark brown spots. Tergum 4 with an additional pair of large subquadrate spiracular yellow spots. Abdominal pleura half pale and half dark except for pleuron 3 which is entirely black.

Hippodamia parenthesis (Say)
(Figs. 47, 48, 131, 134, 159, 163, 227, 228)

Specimens examined

The study was based on six pupae and one pupal exuvia reared from adults collected in East Lansing, Ingham Co., Michigan, on 25 July 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This is the only species among the known pupae of *Hippodamia* with the apical margin of the clypeolabrum slightly concave and never deeply notched, and with the lateral angle of the elytron longer than basal width (never shorter than basal width as in the remaining known pupae of *Hippodamia*).

Description

Length: 4mm-4.5mm; width: 2.5mm. Head dark brown with one pair of irregular 8-shaped or rounded yellow spots. Clypeolabrum dark brown and subquadrate with apical margin more or less truncated or slightly concave (Fig. 47).

Pronotum slightly marginate, bright yellow. In light forms, marginal spots are distinctly present, consisting of two pairs of large subquadrate anterior marginal spots and one pair of large, poorly defined spots at posterior angles, and one pair of basal oval spots (Fig. 131). The outer anterior marginal spots and spots at posterior

angles may fuse together along the lateral margins. The inner anterior marginal spots may expand posteriorly toward the basal spots (Fig. 132, 134). Mesonotum brown at anterior angle and base. Metanotum with one pair of very large bell-shaped spots. Elytron dark brown over one-half of the total surface, with an elongate irregular 8-shaped yellow spot. In light forms, elytral suture and apex brown, two subequal and small spots respectively at humeral and mediosutural area at the basal one-fourth, and a large median spot (as large as or larger than the two previous spots combined) at the basal one-half are distinctly present (Fig. 163).

Abdominal terga bright yellow, each with two pairs of very large subrectangular dark brown spots except that tergum 1 is immaculate or with one pair of small rounded spots, and the pygidium is entirely immaculate. The tergal spots on the abdominal segments are very large, often almost filling the tergal surface except for the median area. Abdominal pleura brownish with marginal area yellowish; pleuron 3 in dark forms is entirely dark brown. Abdominal sterna yellowish to brownish and immaculate.

Hippodamia glacialis (Fabricius)
(Figs. 169, 170)

Specimens examined

The study was based on three pupal exuviae from the U.S. National Museum, collected in association with adults in Massachusetts by Dimmock.

Diagnosis

The maculation pattern of this species and *Hippodamia convergens* is very similar, especially on the elytron. However, it can be separated from *H. convergens* by the poorly developed dorsal tubercles on the abdomen, where in *H. convergens* the dorsal tubercles are greatly developed and directed caudally (Fig. 244). This species also can be distinguished from *H. quinquesignata* by the lack of a transverse band at the subbasal area of the elytron. (See *Hippodamia tredecimpunctata* diagnosis for the separation these two species and *H. parenthesis*).

Description

Length: 6mm; width: 3.5mm. Head rugose and dark brown with two yellowish rounded frontal spots. Clypeolabrum dark brown and rugose with apical margin deeply notched and apical angles subpointed and projected caudally. Antennal scape strongly convex anteriorly.

Pronotum yellowish, slightly marginate along lateral and anterior margins and with four pairs of spots. . . one pair of large subquadrate spots at medioanterior area which are often expanded posteriorly, one pair of elongate oval small spots at the anterior angles, one pair of oval spots at base, and one pair of subquadrate spots at the posterior angles (Fig. 135).

Meso- and metanotum basically yellowish, mesonotum with one pair of small, and metanotum with one pair of large, subcircular dark brown spots. Elytron yellowish (Figs. 169, 170), with a subcircular humeral spot and a mediosutural spot about the

same size as the previous spot at the basal one-fourth, and a median spot twice as large as the other two combined at the basal one-half. Lateral margin of the elytron dark brown; sutural area and lateral angle brown.

All abdominal terga yellowish, each tergum with one pair of large subquadrate dorsal spots and one pair of spiracular spots except for tergum 1 which is immaculate or with one pair of small dorsal spots. Pygidium immaculate. Abdominal pleura immaculate and yellowish except that pleura 3 and the exposed portion of pleuron 2 are dark brown.

Hippodamia convergens Guerin
(Figs. 41, 136, 137, 244)

Specimens examined

The study was based on five pupae and two pupal exuviae reared from adults collected in East Lansing, Ingham Co., Michigan, on 30 June 1971, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and the U.S. National Museum.

Diagnosis

See diagnosis of *Hippodamia tredecimpunctata, H. parenthesis,* and *H. glacialis* for the separation of this species from the group.

Description

Pupae of this species are very similar to *Hippodamia glacialis,* especially the maculation pattern on the elytron.

Length: 5mm-5.5mm; width: 3mm-3.30mm. Head entirely dark brown except for the pale yellowish mediolongitudinal line. The pronotum in dark forms has two pairs of subequal subquadrate dark brown spots, one pair at the medioanterior marginal area and the other pair at the base, and two other pairs of spots at the anterior and posterior angles which are always fused together along the lateral marginal areas (Figs. 136, 137). Discodorsal area of the pronotum varies from very light brown to brown. Meso- and metanotum pale yellowish. Mesonotum with one pair of small, and metanotum with one pair of large subtriangular spots. In dark forms, mesonotum entirely dark brown except for the pale mediolongitudinal line. Scutellar area of the mesonotum always brownish to dark brown.

The dorsal tubercles on the abdomen are characteristically well developed in this species where they are greatly elevated and directed caudally.

Hippodamia quinquesignata (Kirby)
(Figs. 135, 158, 164-168)

Specimens examined

The pupae and adults were collected in Idaho in a cluster, mixed with several different species, on 31 July 1969 by R. W. Portman. Based on the similarity to the maculation pattern of the elytra of the adults pupae were carefully selected to have

the greatest possibility of correct identification. The variation of maculation pattern within the species is therefore very limited in this study.

The study was based on 16 selected pupae consisting of a single form. Four specimens are deposited in the Entomology Museum of Michigan State University, the rest were returned to the University of Idaho.

Diagnosis and description

Hippodamia quinquesignata is very similar to *H. glacialis* and *H. convergens* but differs in the maculation pattern on the elytron. The humeral spot and the mediosutural spot at the basal one-fourth are transversely fused into a transverse band extending from the subsutural area to the humeral angle (Figs. 166-168). In lighter forms, the subbasal transverse band on the elytron becomes obsolete; in this case, an L-shaped subscutellar spot is characteristic of this species (Figs. 164, 165).

In addition, this species can also be separated from *H. glacialis* and *H. convergens* by the eighth abdominal tergum being glabrous; in *H. glacialis* and *H. convergens* the eighth abdominal tergum is finely setiferous.

Genus COLEOMEGILLA Timberlake

Coleomegilla maculata (DeGeer)
(Figs. 43, 124-126, 155, 156, 174)

Specimens examined

The study was based on 18 pupae and eight pupal exuviae which were reared from adults collected in East Lansing, Ingham Co., Michigan, 30 June 1972, by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Diagnosis

This species, along with the closely relaged genera *Naemia* and *Eriopis,* form a group which is separated from *Hippodamia* by having the exposed intersegmental conjunctivae finely setiferous, and by having the lateral angle of the elytron obtuse, rounded, and almost continuous with the lateral margin (Figs. 155-156). *Coleomegilla* in turn is separated from *Naemia* by the first abdominal spiracles being partly hidden under the elytra (in *Naemia* the 1st abdominal spiracles are entirely hidden under the elytra), and from *Eriopis* by the apical margin of the clypeolabrum being slightly concave, whereas in *Eriopis* the apical margin of the clypeolabrum is deeply notched.

Description

Length: 4.5-5mm; width: 2.2-2.8mm. Body very elongate oval, yellowish and finely setiferous, with well-defined dark brown spots on dorsal surface.

Head yellowish to light brown (supra ocular area sometimes brown) with the frons always pale; surface smooth or slightly rugose. Antennae long, extending over two-thirds of the distance between the eye and the widest lateral margin of the pronotum.

Scape largely expanded caudally and flat. Flagellum elbowed and subquadrate in cross section. Club distinctly subspherical and with three rings of papillae, although the last ring is more or less obsolete. Clypeolabrum subquadrate, as long as or slightly shorter than wide, with apical margin slightly concave and apical angles rounded (Fig. 43). Mandible sharply bifid at tip. Maxillary palpi large, trapezoidal, yellowish to brown and smooth. Galea smooth without teeth.

Pronotum yellowish, large, subrectangular, deeply marginate along anterior and lateral margins, anterior margin strongly carinate and slightly projected anteriorally (Fig. 126); a large pair of oval spots usually present at base (Figs. 124-125). Meso- and metanotum each with one pair of large suboval dark brown spots in dark forms, whereas in light forms, the spots on the mesonotum are wanting or very light brown. Elytron smooth, finely setiferous, three times as long as wide. Epipleura wide and slightly concave; lateral angle of the elytron rounded obtuse and almost continuous with the lateral margin (Fig. 156). Elytra usually with well-defined dark brown spots, consisting of a scutellar spot and a subsutural spot at basal two-thirds (these two spots are usually fused with sutural dark area), a humeral rounded spot, and two median spots, one at the basal two-fifths, and one at the apical one-fifth. The first medial spot large and subrectangular, extending from the lateral margin almost to the sutural dark area; the second medial spot is light brown and much smaller than the humeral spot; and finally, a distolateral poorly defined light brown spot. In some cases, the spots may become light or absent. Hind wing membranous, tapered apically and glabrous. Legs long, with femora slender and somewhat cylindrical, extending considerably beyond the widest lateral margins of the pronotum, finely setiferous and brown to dark brown except for the pale femoral bases and tibiotarsal joints. Hind femorotibial joints visible dorsally.

Abdominal terga yellowish, finely and densely setiferous (including median area). Dorsal tubercles wanting. The exposed intersegmental conjunctivae finely setiferous. Most terga usually with one pair of lateral and one pair of dorsal spots which are often fused together except for the median area between the dorsal spots. Terga 7 to 9 are immaculate, and tergum 1 is either immaculate or with 2 small poorly-defined dorsal spots. Tergum 8, pygidium and urogomphi are glabrous. Abdominal spiracles circular or nearly so, except for the first which is large, elongate oval and mostly hidden beneath the elytra. Abdominal pleura subquadrate with lateral margin convex; surface smooth, yellowish and finely setiferous except for the first 2 pleura which are pale and hidden beneath the elytra. Abdominal sterna immaculate, pale yellowish, and finely setiferous except for sterna 8 and 9 which are glabrous.

Genus NAEMIA Mulsant

Naemia seriata (Melsheimer)
(Fig. 42)

Specimens examined

The study was based on two pupae, including one reared exuvia of *Naemia seriata* collected in Mayo Beach, Maryland, 30 August 1944 by E. A. Chapin. The specimens were loaned from the U.S. National Museum.

Diagnosis

See diagnosis of *Coleomegilla maculata* for separation of these two species.

Description

The species is similar to *Coleomegilla maculata* in many respects except the following:

Length: 4-4.5mm; width: 2.5mm. Clypeolabrum tapering apically. Apical margin concave and narrow, about one-half as wide as the base (Fig. 42).

Lower margin of anterior edge of the pronotum descending about two-thirds of the eye length (Fig. 42). Elytral maculation pattern as in *Coleomegilla maculata,* but spots with an equal degree of brownness, and a common sutural and a common scutellar spot present. Legs short, not extended much beyond lateral margin of the pronotum (Fig. 42). Abdominal tergum 1 with two large but poorly defined dorsal spots. First abdominal spiracles entirely hidden under the elytra.

Genus ERIOPIS Mulsant

Eriopis connexa (Germar)
(Figs. 7, 49, 127, 157, 175)

Specimens examined

The study was based on 10 pupae of *Eriopis connexa* reared in Berkeley, California, by R.L. Tassan. The specimens were loaned from Dr. K. S. Hagen's collection.

Diagnosis

This genus appears to have some close affinity to *Hippodamia* because the pronotum is very slightly marginate and rugose, the antennal scape is strongly convex, and the clypeolabrum is deeply notched at apical margin. In contrast, the wing form shows more affinity to *Coleomegilla* in which the lateral angle is obtuse and almost continuous with the lateral margin of the elytron. In general, this species is distinctly separated from *Coleomegilla* by the sharply notched apical margin of the clypeolabrum (Fig. 49) and by the slightly angulate lateral margins of abdominal pleura 3 to 5 (Fig. 175) (in *Coleomegilla* the apical margin of the clypeolabrum is slightly concave and the lateral margin of the abdominal pleura 3 to 5 is rounded convex). It is separated from *Hippodamia* by the exposed finely setiferous intersegmental conjunctivae on the dorsum of the abdomen, and by the obtuse and rounded lateral angle of the elytron (in *Hippodamia* the exposed intersegmental conjunctivae on the dorsum of the abdomen are glabrous and the lateral angle of the elytron is greatly expanded anteriorly into a broad rounded lobe).

Description

Length: 5.5mm; width: 3mm. Body elongate, moderately convex dorsally and apparently glabrous.

Head dark brown along lateral area, including eyes and antennae; discal area yellow. Antennae long, extending to the widest lateral margins of the pronotum; club with 4 rings of poorly developed papillae, with the diameter subequal to that of the flagellum. Scape convex and rugose. Clypeolabrum large, dark brown except medially, with apical margin angularly and deeply notched; surface slightly rugose. Maxillary palpi large with lateral margin sinuate (Fig. 49).

Pronotum subquadrate, about one-third wider than long, shiny yellow, slightly and regularly rugose, very slightly marginate, and with 2 large but not well-defined basal brownish spots (Fig. 127). Prothoracic spiracle rounded oval. Meso- and metanotum each with one pair of subtriangular spots. Elytron yellow, elongate (3 times longer than wide) with lateroapical angle obtuse, and almost continuous with lateral margin. Sutural and lateral margin dark brown. Hind wings glabrous. Legs long and slender, with front femora extending considerably beyond lateral margins of the pronotum. Abdomen yellow and slightly rugose dorsally. Each tergum with one pair of large but not well-defined subrectangular spots (except terga 1, 7, 8, 9 which are immaculate). Exposed intersegmental conjunctivae on abdomen finely setiferous. Abdominal pleura subquadrate, yellow and immaculate, with lateral margin slightly angulate (Fig. 175).

TRIBE PSYLLOBORINI

Diagnosis

See diagnosis of Coccinellini for separation of these two tribes.

Genus PSYLLOBORA Chevrolat

Psyllobora vigintimaculata (Say)
(Figs. 46, 92, 229)

Specimens examined

The study was based on over 30 pupae of *Psyllobora vigintimaculata* which were reared from adults collected in Clinton Co., Michigan, 10 June 1972 by Dang T. Phuoc. The specimens are deposited in the Entomology Museum at Michigan State University and in the U.S. National Museum.

Description

Length: 2.5-3mm; width: 1.5-1.8mm. Body slightly elongate oval, finely setiferous, pale whitish, with a few dark spots on dorsal surface. Head pale except for light brown eyes. Antennae very long with the tips hidden beneath the front femora, and more than twice as long as the distance between the antennal bases. Club not distinct from the flagellum and with 2 entire rings of well developed papillae (Fig. 46). Clypeolabrum subrectangular, about twice as wide as long, with apical margin truncated or very slightly concave (Fig. 46). Mandible bifid. Maxillary palpi bell-shaped, with the apex greatly enlarged (Fig. 46); galea greatly enlarged and rounded as seen from the top, with the greatest width as wide as the base of maxillary palpus (Fig. 92).

Pronotum pale whitish, with anterior margin slightly concave and slightly marginate along anterior and lateral margins. Meso- and metanotum also pale whitish, each with one pair of subrounded dark brown spots. Elytron subrectangular,

immaculate, whitish and finely setiferous. Lateral angle of the elytron obtuse and lateral margin marginate. Legs short and pale except for terminal "segment" which is brownish with pointed "claws" (Fig. 46).

Abdominal terga pale whitish and immaculate, except that the first 2 terga have one pair of poorly defined brownish spots on each, and the third tergum with 2 pairs of more distinct spiracular and dorsal subquadrate spots. Urogomphi well developed and similar to Coccinellini. Abdominal spiracles circular. Abdominal pleura pale, subquadrate, and with the lateral margin rounded and convex, except for pleura 2 and 3 which are brownish at the posterior and anterior marginal areas respectively. Abdominal sterna entirely immaculate and pale.

DISCUSSION AND CONCLUSIONS

Based on adults, the taxonomy of the Coccinellidae has been fairly well worked out. From this standpoint, several systems of classification within the family have long been proposed and used. The history of the classification of the family based on adult characters was presented by Watson (1956) and by Sasaji (1968b, 1971). The system which has been most accepted by many authors is that proposed by Korschefsky (1931, 1932) in which the family Coccinellidae contains three subfamilies: the EPILACHNINAE, the LITHOPHILINAE with the monotypic genus *Lithophilus* Frolich, and the COCCINELLINAE which contains the majority of the members of the family. The system has not been greatly altered except some tribal rearrangements have been attempted. Watson (1956) proposed that the Coccinellini should be recognized as the three different tribes Coccinellini, Hippodamiini and Anisostictini after careful study of the morphology of the adults, despite the fact that Boving (1917), an early author who carefully studied the larval stages of COCCINELLIDAE, pointed out that the COCCINELLINI and HIPPODAMIINI can not be separated by using characters of the larvae.

A number of authors have worked on coccinellid larvae, including Boving (1917), Gage (1919), Strouhal (1926), Rees (1947, 1948), Van Emden (1949), Kapur (1950) and recently Savoiskaya (1960, 1962a, 1962b, 1962c, 1963, 1964a, 1964b), Kamiya (1965), and Sasaji (1968a). Using larval characters Kamiya (1965) proposed new phylogenetic relationships among coccinellid tribes in which he considered EPILACHNINAE to have independently evolved from the COCCINELLINAE, the tribes COCCINELLINI and PSYLLOBORINI to be closely related and highly developed, the tribes HYPERASPINI, PLATYNASPINI, TELSIMINI, SCYMNINI, STETHORINI, NOVIINI, and CHILOCORINI to have branched from another stem in which the members of CHILOCORINI are most advanced, and the SUKUNAHIKONINI, SERANGIINI and PHARINI to be another stem. He also emphasized that members of HYPERASPINI and SUKUNAHIKONINI stand as the most primitive forms in the family.

After careful study of adult and larval characters Sasaji (1968b) (newly adopted name of Kamiya) came up with a new system of classification in which the family is divided into six subfamilies, the STICHOLOTINAE, SCYMNINAE, CHILOCORINAE, COCCIDULINAE, COCCINELLINAE and EPILACHNINAE.

He proposed a new tribal phylogeny and relationships which do not agree entirely with his previous work. He thought the EPILACHNINAE were very closely allied with the COCCINELLINAE, but had evolved divergently with the change of feeding habits from carnivorous to phytophagous. He also emphasized that these two subfamilies have evolved from a Sticholotine-like ancestor, with STICHOLOTINAE as the most primitive group in the family. On the other hand, he believed the CHILOCORINAE and SCYMNINAE are closely related and have evolved on a separate stem without any close connections to any other groups. Finally, he stated that although both groups were primitive, the COCCIDULINAE and STICHOLOTINAE did not have great affinity. Moreover, within the COCCIDULINAE, the NOVIINI appear to have a closer affinity to SCYMNINI or ORTALIINI than to the COCCIDULINI. Therefore, the branching point of COCCIDULINAE was still very much in doubt.

Information on the pupae has never been used in the classification of the family Coccinellidae. However, from the material examined in this study, it is possible to arrive at some conclusions concerning the tribal relationships.

By the study of the comparative morphology of the pupae, the relative degree of advanced or primitiveness of the pupal characters has been determined by the application oof Maslin's concepts (1952) on the use of morphological criteria for phyletic relationships (see Table 1).

For the following discussion refer to the phylogenetic diagram (Fig. 266).

The COCCINELLINAE contains three tribes COCCINELLINI, PSYLLOBORINI and DISCOTOMINI (Sasaji, 1971), but pupae for the last tribe were not available. Based on pupal characters, the COCCINELLINAE is the most highly advanced subfamily and has evolved along a distinct line in which they, without exception among known pupae for the family, have distinct maculation on the dorsal body surfaces, have exposed conjunctivae between the abdominal segments which allow for expansion of the abdomen by means of a unique folding mechanism, and have fine and rather inconspicuous setae.

The PSYLLOBORINI are almost identical to the COCCINELLINI except for their smaller size and having a greatly enlarged galea. As Sasaji (1968b) pointed out, the PSYLLOBORINI have recently diverged from the predaceous COCCINELLINI in adopting tthe fungiphagous habit. This opinion is substantiated by the morphology of the pupae.

The remainder of the family is distinctly separated from the COCCINELLINAE by their usually pale and immaculate bodies, by the more or less compact abdomen in which the abdominal terga are firmly attached to one another without the intervening exposed conjunctivae, and usually by the presence of coarse, long, and very conspicuous setae. Therefore, they are probably a monophyletic group which evolved from a common ancestor which is widely separated from the COCCINELLINAE.

The EPILACHNINAE split off early from this group, and independently acquired the phytophagous habit and highly evolved mandibles whose tip is bifid and broadly concave mesally.

Following the EPILACHNINAE, the STICHOLOTINAE-COCCIDULINAE group diverged from the main stem of branch 1, evolving from a common ancestor which acquired setae at the apex of the hind wings.

TABLE 1.— Phyletic rating of selected pupal characters in the Coccinellidae

Pupal Characters Primitive → Advanced (0) (5)	Coccinellid Tribes Studied	Sticholotini	Serangiini	Noviini	Scymnillini	Coccidulini	Epilachnini	Chilocorini	Hyperaspini	Scymnini	Stethorini	Psylloborini	Coccinellini
ABDOMEN (Unflexible → flexible)		0	0	0	0	0	0	0	0	0	0	5	5
MACULATION PATTERN (Immaculate → maculate)		0	0	1	0	0	1	1	0	0	0	3	5
Coarsely setiferous → finely setiferous → apparently glabrous → glabrous		0	0	0	0	0	0	0-3	0	0	0	5	5
ANTENNAE (Clubless → clubbed)		4	4	0	0	4.5	3	0	0	2	2	4	4-5
MANDIBLES (Tip simple → tip bifid)		0	0	4	2	4	5	0-0.5	3	3	3	4	4
FRONTAL AREA (Sclerotized → membranous)		0	0	0	0	0	0	0	0	0	5	0	0
CLYPEOLABRUM (Longer than wide → wider than long)		1	2	4	3	5	3	4.5	4	4.5	4	5	4
ELYTRON (Lateral margin) (Nonmarginate → strongly marginate		0	0	0	0	0	0	0	0	0	0	5	5
HIND WING APEX (Setiferous → glabrous)		0	0	0	0	0	5	5	5	5	5	5	5
ABDOMINAL SPIRACLES (Absent → nonpedunculate → pedunculate)		2	2	1	2	2.5	3-4	4	0	2	3	2	2
UROGOMPHI (Absent → present → complex)		0	0	4	1	1	1	3-4	5	2-3	2	4	4

The STICHOLOTINAE, according to Sasaji (1971), consists of four tribes: SHIROZUELLINI, STICHOLOTINI, SERANGIINI and SUKUNAHIKONINI. Unfortunately, pupae were available for only the STICHOLOTINI and SERANGIINI, but they appear to be the most primitive group within the family for they have retained many primitive characters (see Table 1).

According to Sasaji (1971) COCCIDULINAE contains the tribes NOVIINI, EXOPLECTRINI, LITHOPHILINI, AND COCCIDULINI. Only pupae of the NOVIINI, COCCIDULINI, (and SCYMNILLINI) were available for this study. Because of the presence of setae on the pupal hind wing apex, the SCYMNILLINI are more closely related to the COCCIDULINI than to the SCYMNINI. Therefore, the tribe SCYMNILLINI should be included in the COCCIDULINAE instead of the SCYMNINAE.

The COCCIDULINAE appear to be more advanced than the STICHOLOTINAE; however, they are far less advanced than the remaining groups of the family. On one hand, the COCCIDULINI appear to be more closely related to EPILACHNINI than any other groups of COCCINELLIDAE outside of the COCCIDULINAE by retaining the first four slightly pedunculated abdominal spiracles, and by having the urogomphi slender with a simple apex. The NOVIINI, on the other hand, appear to have a closer relationship to the CHILOCORINI (CHILOCORINAE) and the HYPERASPINI (SCYMNINAE) than to the SCYMNILLINI and COCCIDULINI by having short, clubless non-papillated antennae, bipartite urogomphi whose apices are modified into a complex distal disk, and the subquadrate abdominal pleura in a subvertical position.

The CHILOCORINAE contains three tribes according to Sasaji (1971), the CHILOCORINI, PLATYNASPINI, and TELSIMIINI. Only pupae of the CHILOCORINI were available. The CHILOCORINI appear to have evolved along a separate branch by acquiring a broadly expanded clypeus. They show some degree of relationship with the STICHOLOTINAE-COCCIDULINAE group by retaining the primitive simple mandibles and the clubless non-papillated antennae which may be found in the STICHOLOTINAE (*Microweisea ovalis, Delphastus pusillus*) and in the SCYMNILLINI (*Zagloba ornata*).

Finally, according to Sasaji (1971) the SCYMNINAE consists of seven tribes, the ORTALIINI, ASPIDIMERINI, SCYMNINI, HYPERASPINI, CRANOPHORINI, STETHORINI, and SCYMNILLINI. However, the SCYMNILLINI have been shown above to belong to the COCCIDULINAE. Only pupae of the SCYMNINI, HYPERASPINI and STETHORINI were available. The SCYMNINAE have recently branched from branch 1. The STETHORINI appear to be the most highly evolved tribe with the frontal area entirely membranous, the well-defined pedunculate first abdominal spiracles, and the glabrous frons, clypeolabrum and pygidium. By having the well pedunculated first abdominal spiracles, STETHORINI appear to have close relationships with the CHILOCORINI. In contrast, the HYPERASPINI are the most primitive tribe in the SCYMNINAE, even though they have acquired some highly evolved characters such as the strongly sclerotized and complex distal disk of the urogomphi.

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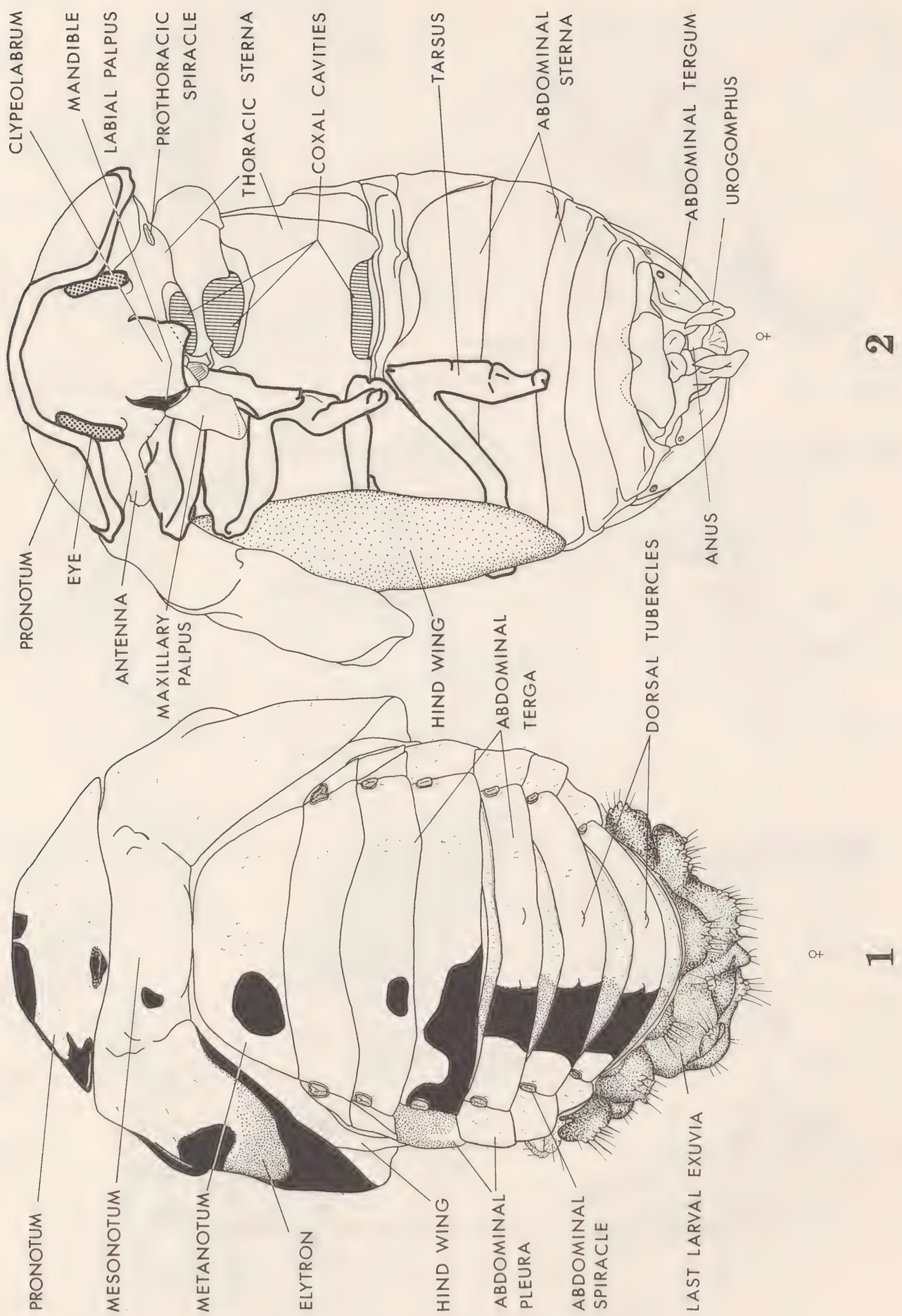
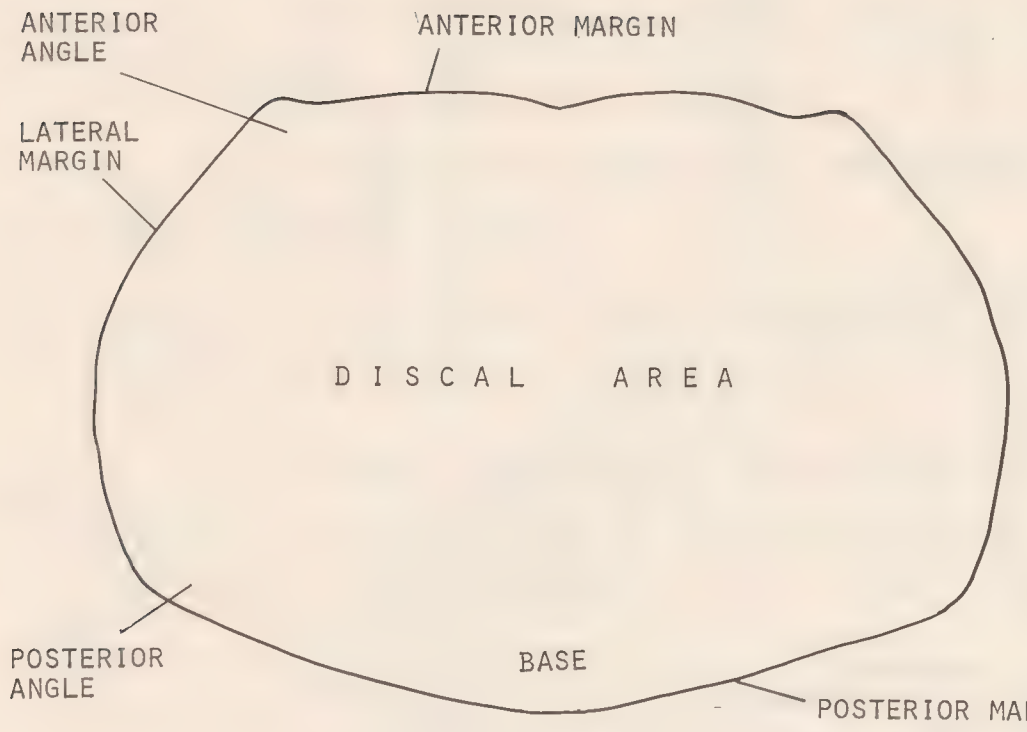


Figs. 1-2. General morphological details of coccinellid pupae.
Fig. 1. *Coccinella novemnotata* ♀ , dorsal aspect.
Fig. 2. *Coccinella novemnotata* ♀ , ventral aspect.



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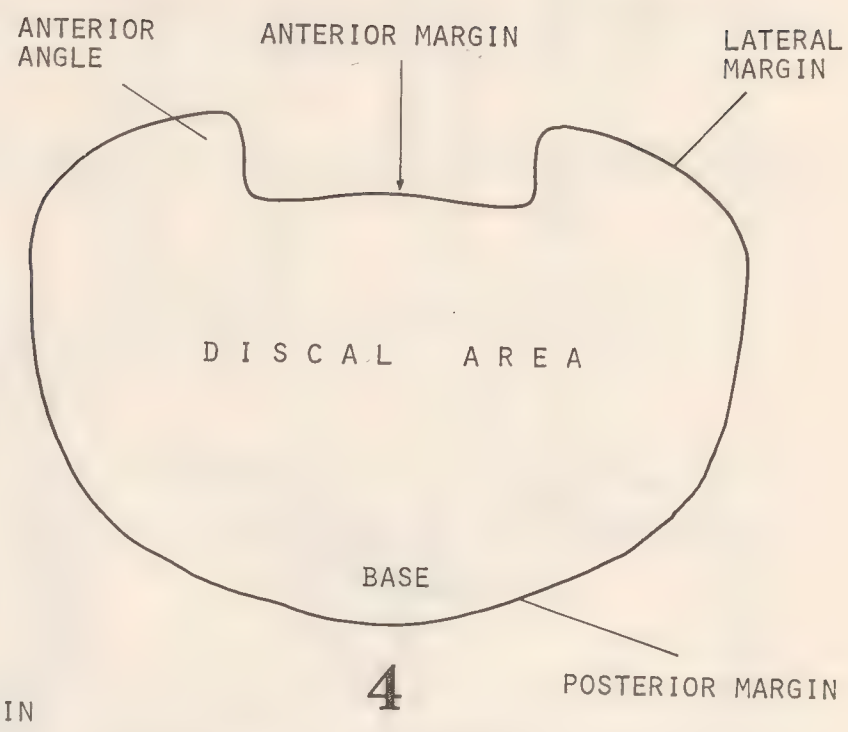

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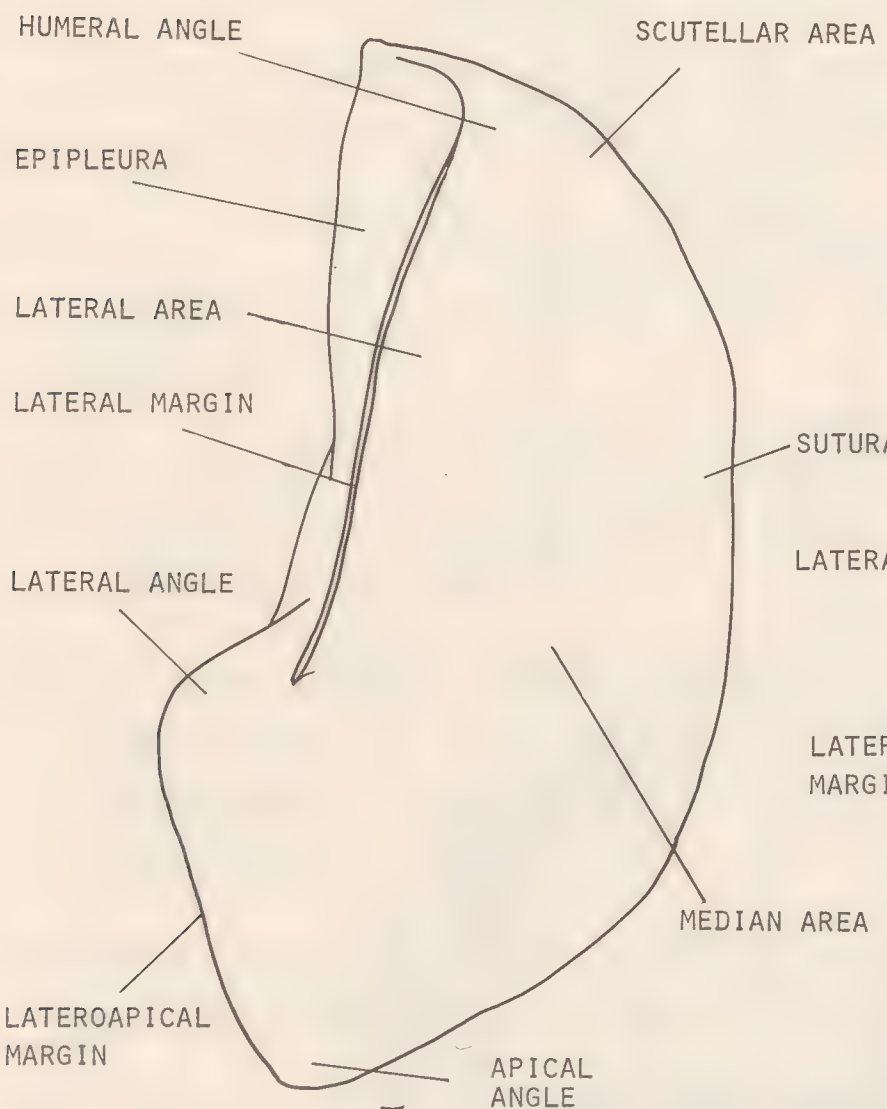

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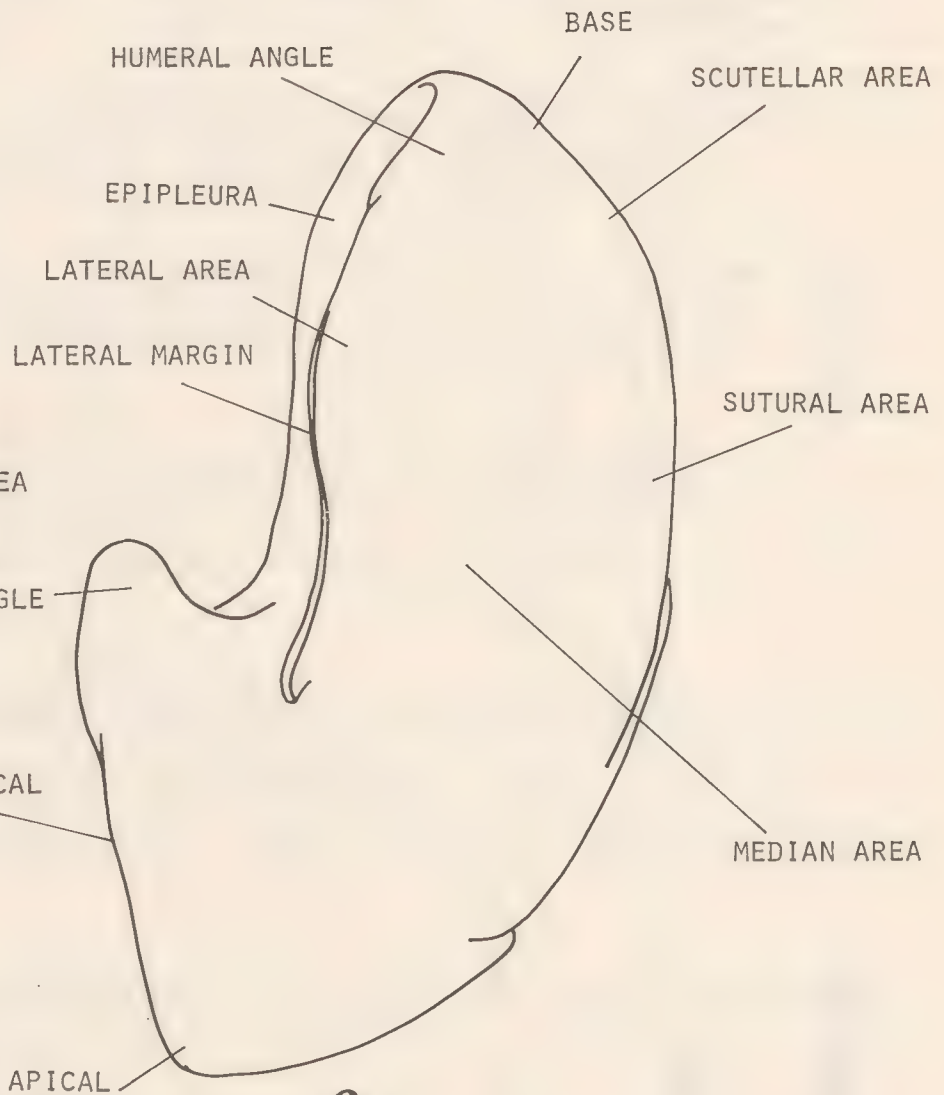

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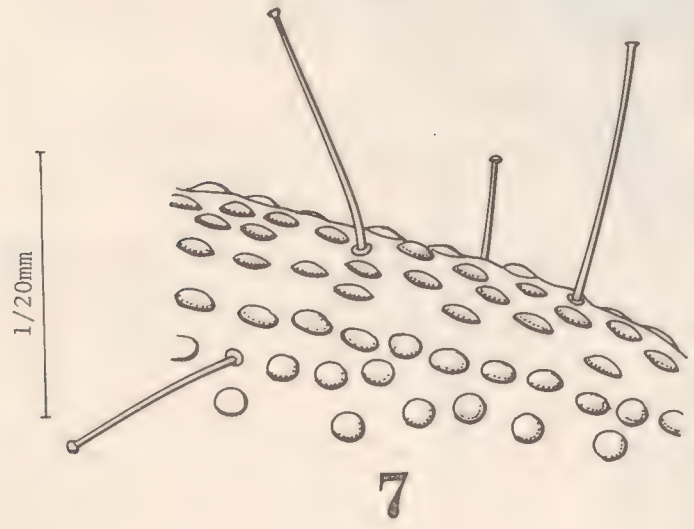

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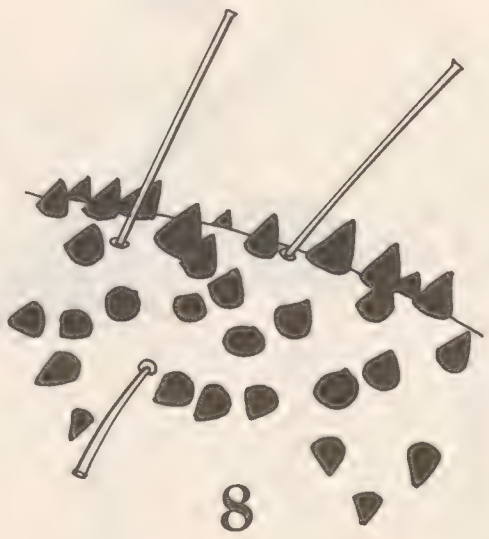

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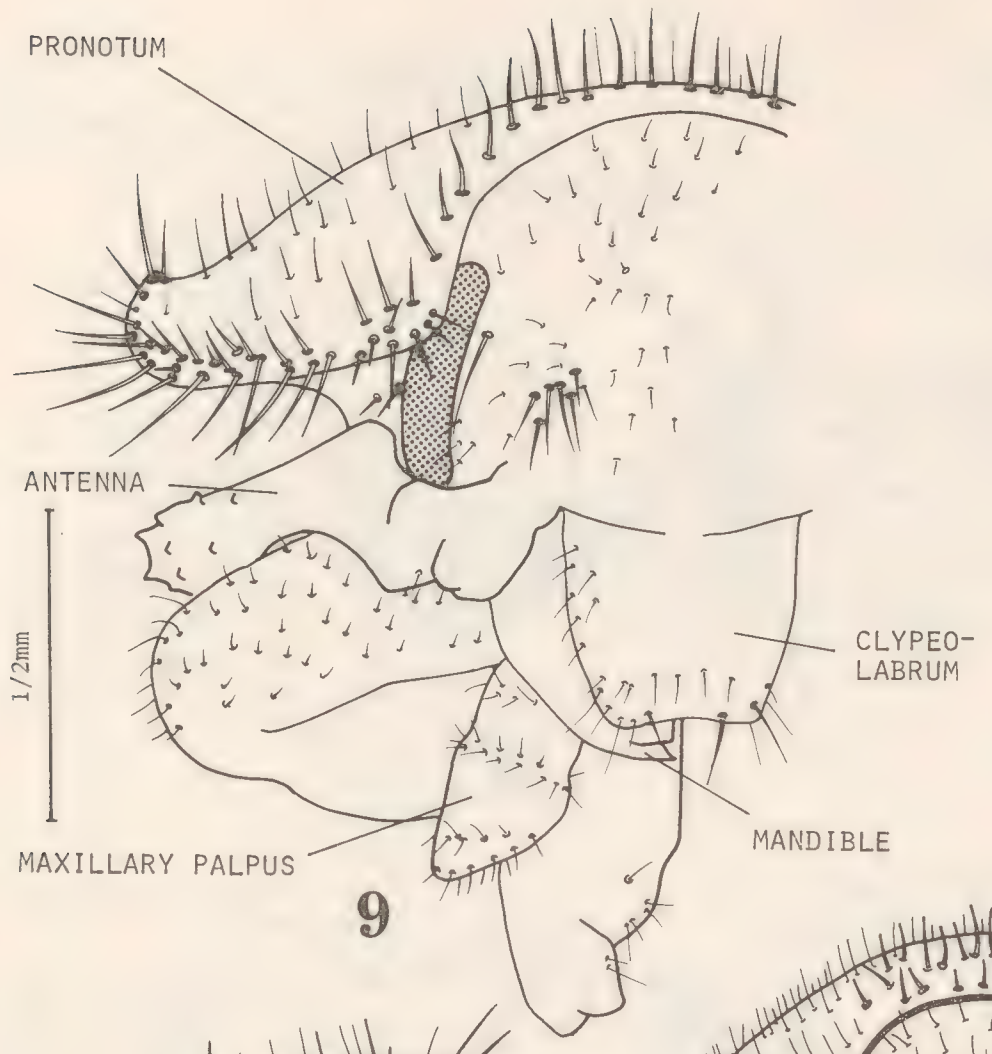
Figs. 3-4. General areas on the pronotum of coccinellid pupae (dorsal aspect).
Figs. 5-6. General areas on the elytra of coccinellid pupae.
Fig. 7. *Eriopis connexa,* a close-up portion of the surface of the apical margin of the elytron.
Fig. 8. *Coccinella novemnotata,* a close-up portion of the surface of apical margin of the elytron.



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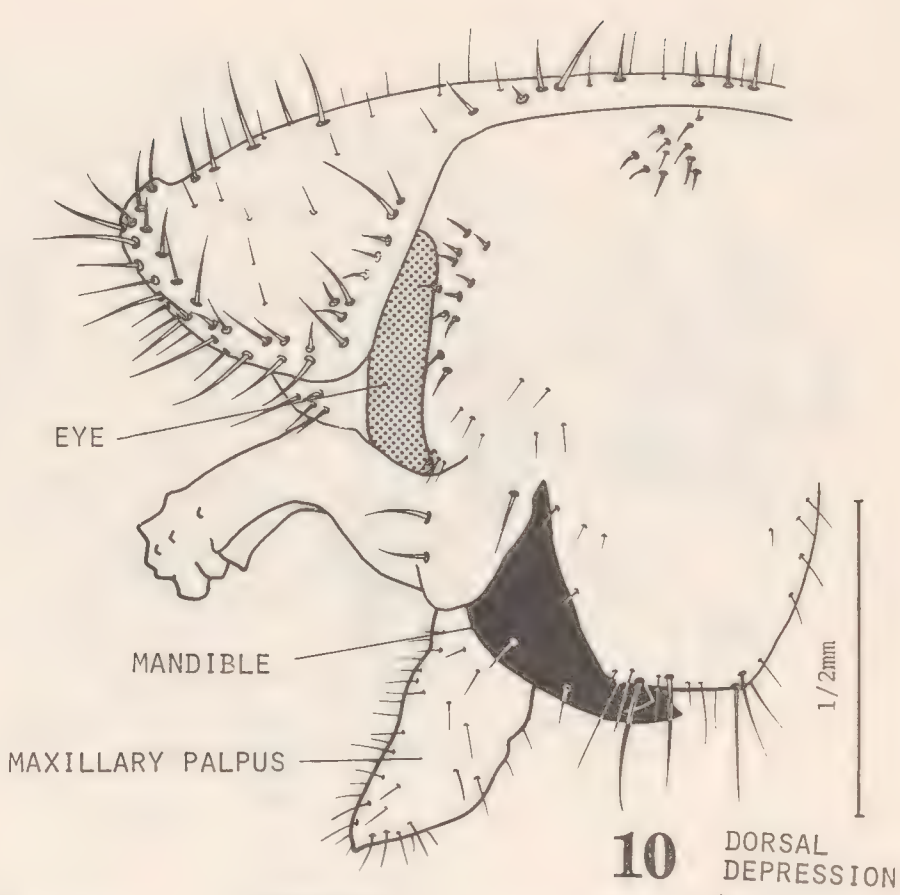

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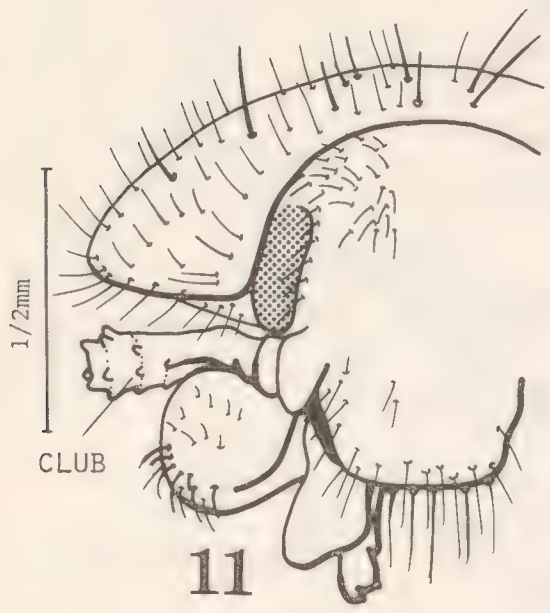

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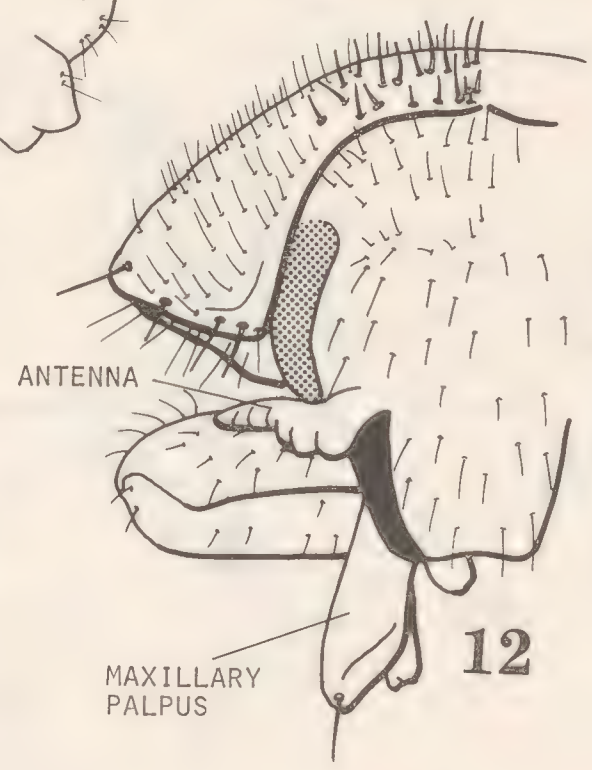

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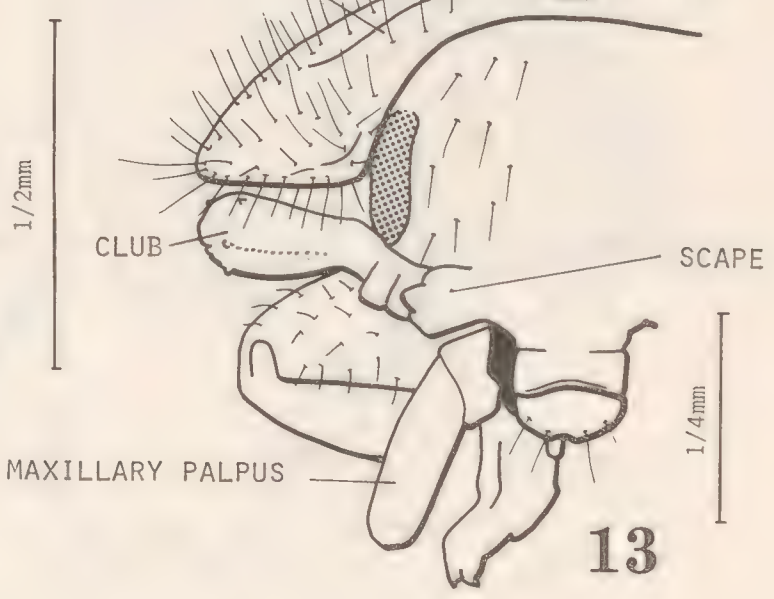

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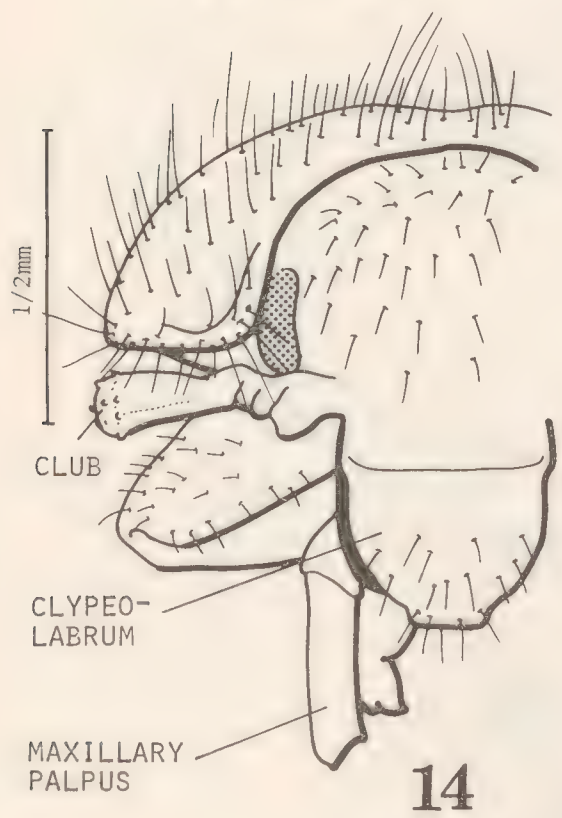

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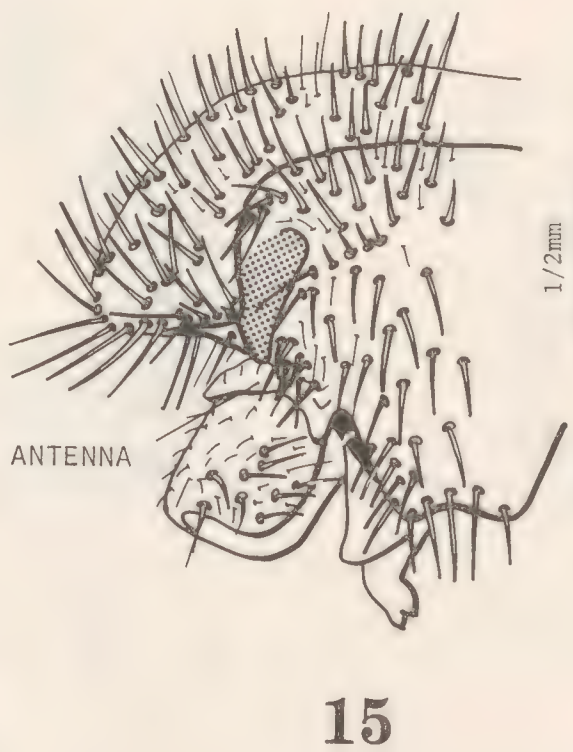

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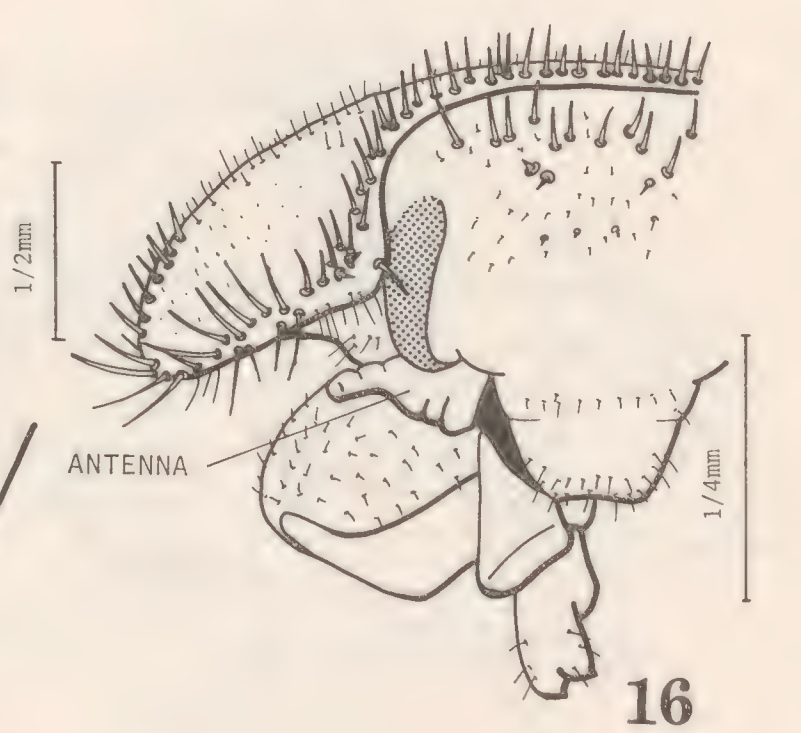

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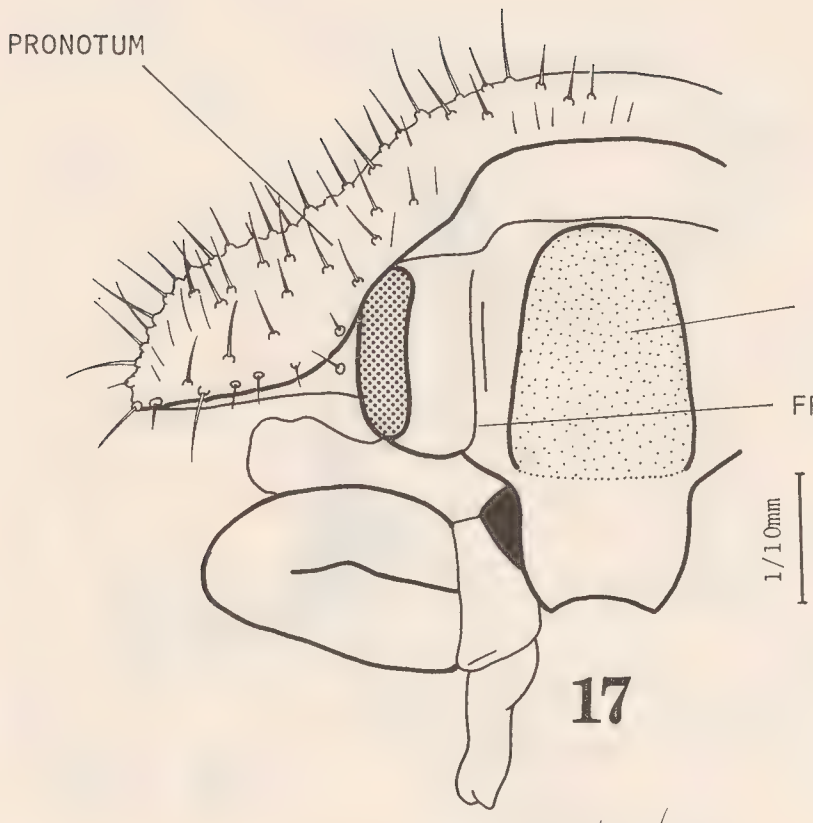
Figs. 9-16. Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.
Fig. 9. *Epilachna borealis*
Fig. 10. *Epilachna sp.*
Fig. 11. *Lindorus lophantae*
Fig. 12. *Zagloba ornata*
Fig. 13. *Delphastus pusillus*
Fig. 14. *Microweisea ovalis*
Fig. 15. *Hyperaspis binotata*
Fig. 16. *Thalassa montezumae*



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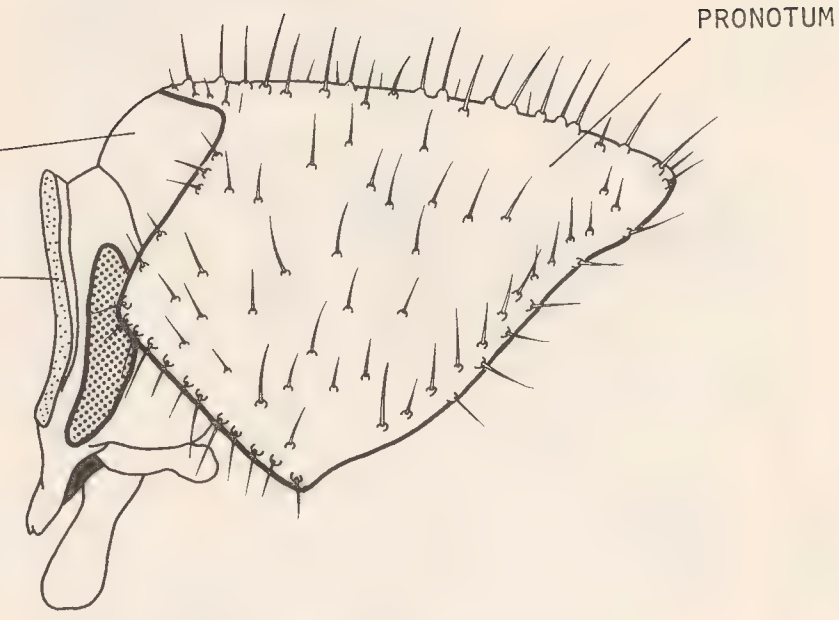

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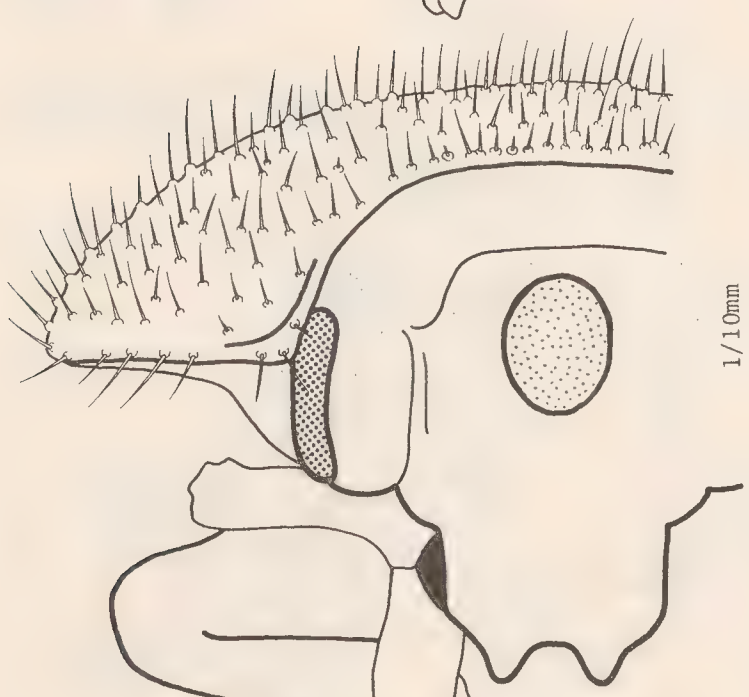

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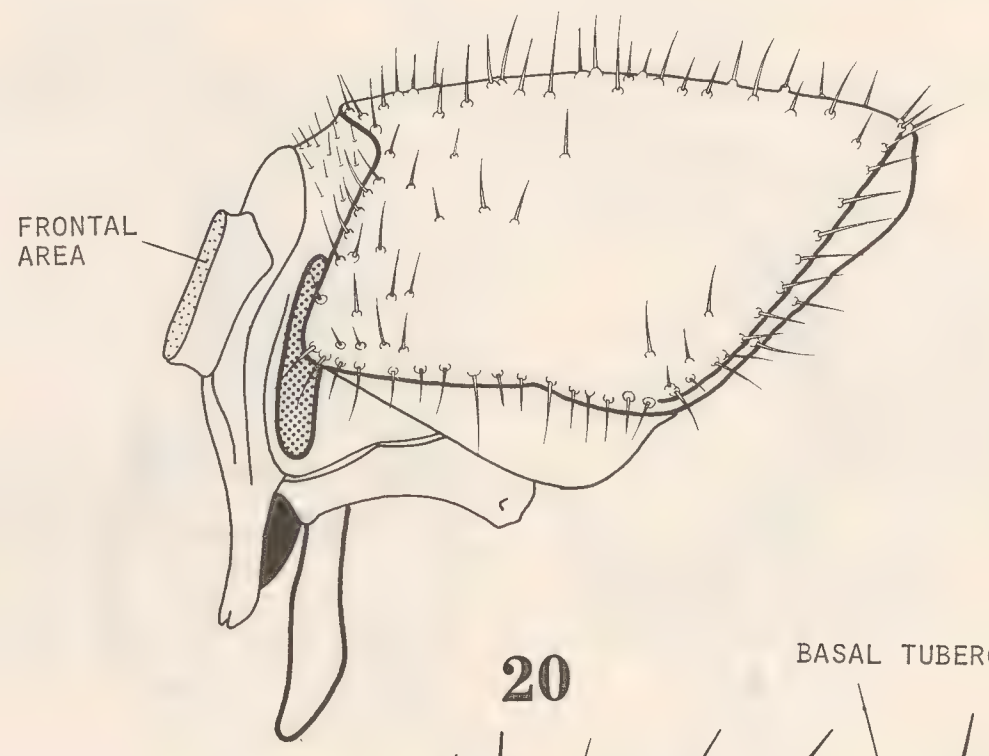

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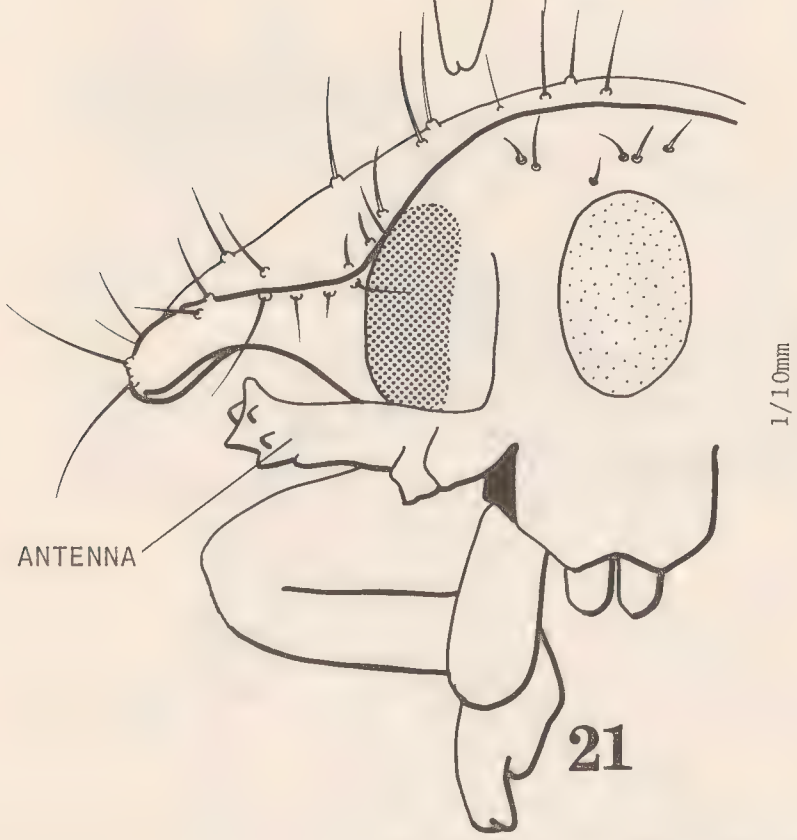

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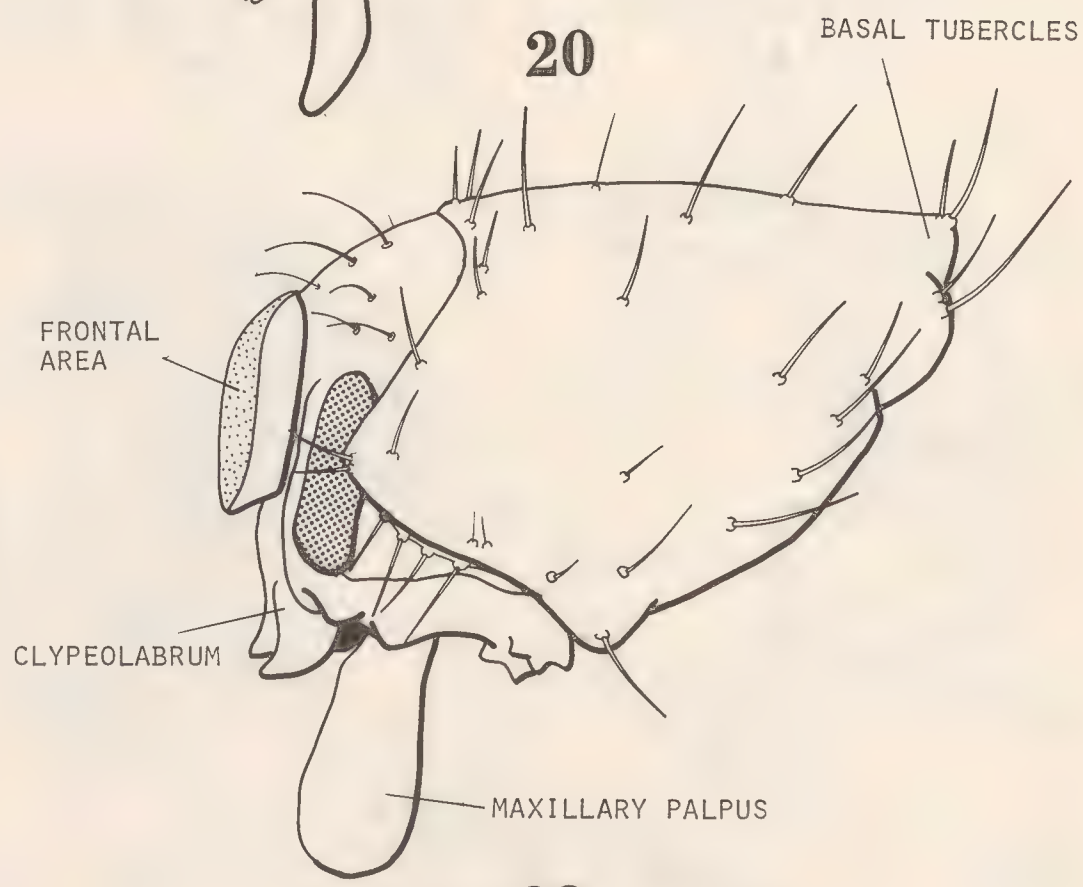
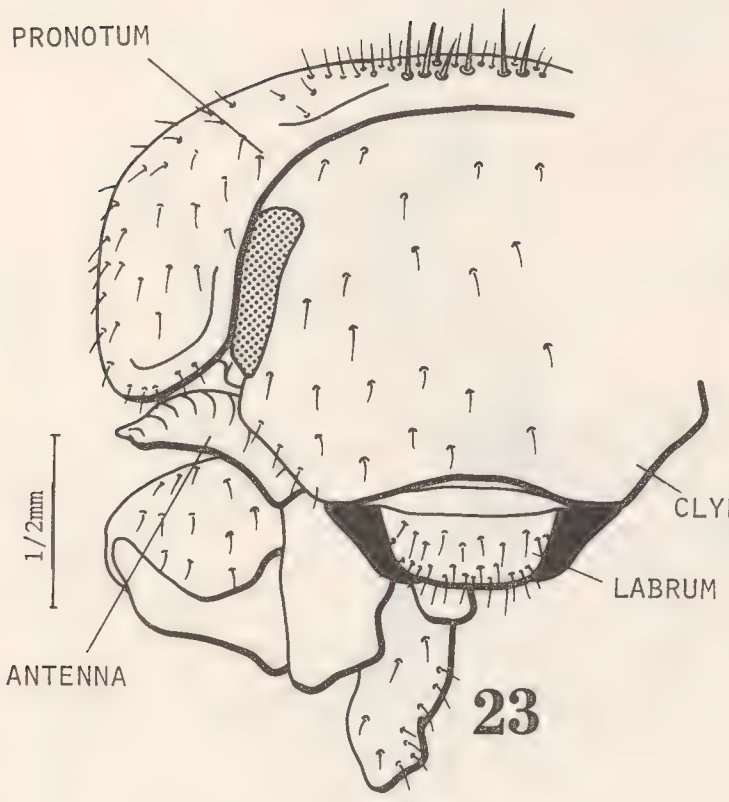


22

Figs. 17-22: Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.
Fig. 17. *Stethorus punctum*
Fig. 18. *Stethorus punctum* (lateral aspect)
Fig. 19. *Stethorus picipes*
Fig. 20. *Stethorus picipes* (lateral aspect)
Fig. 21. *Stethorus atomus*
Fig. 22. *Stethorus atomus* (lateral aspect)



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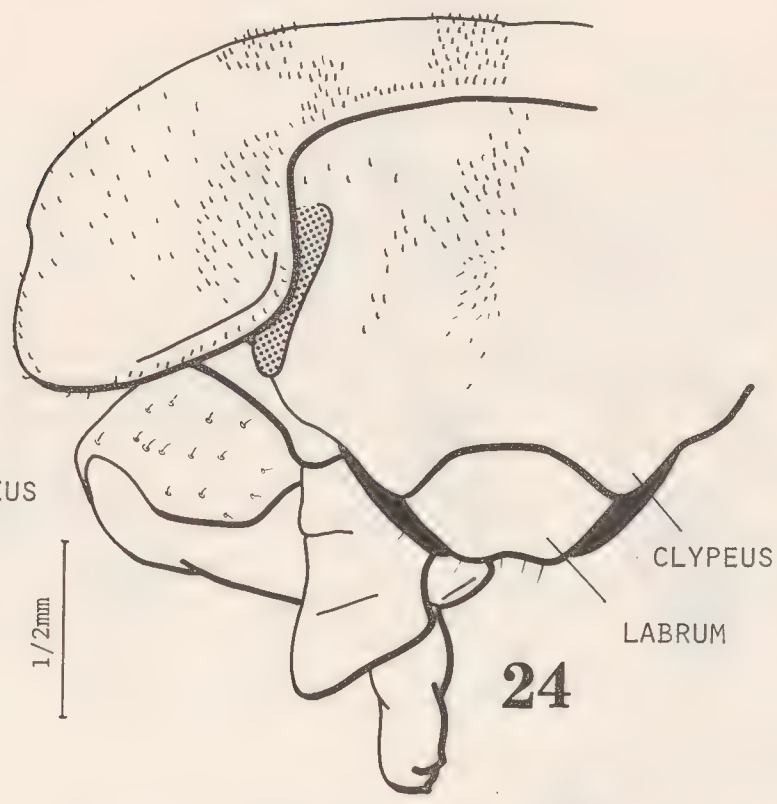

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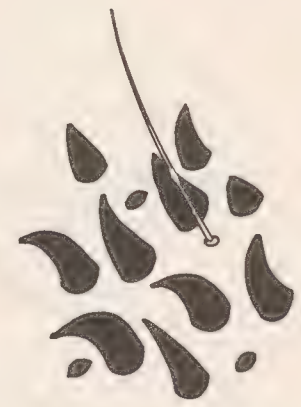

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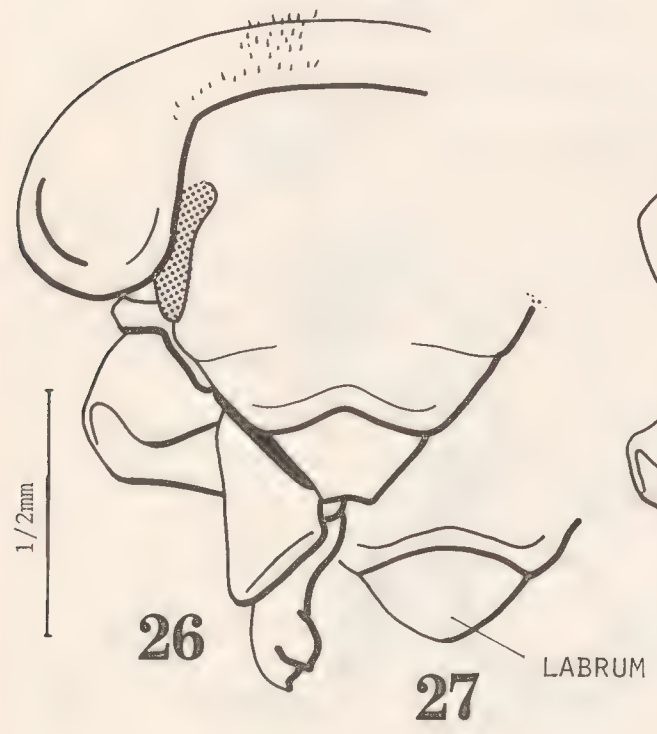

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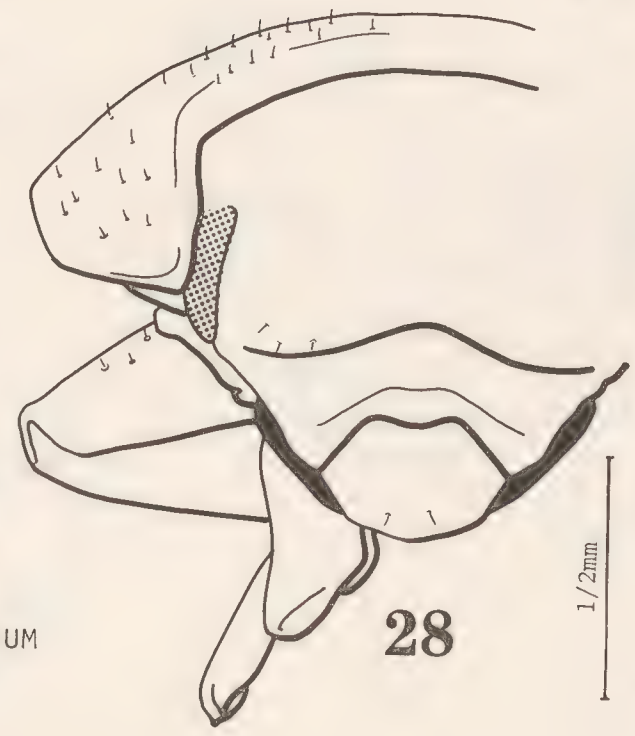

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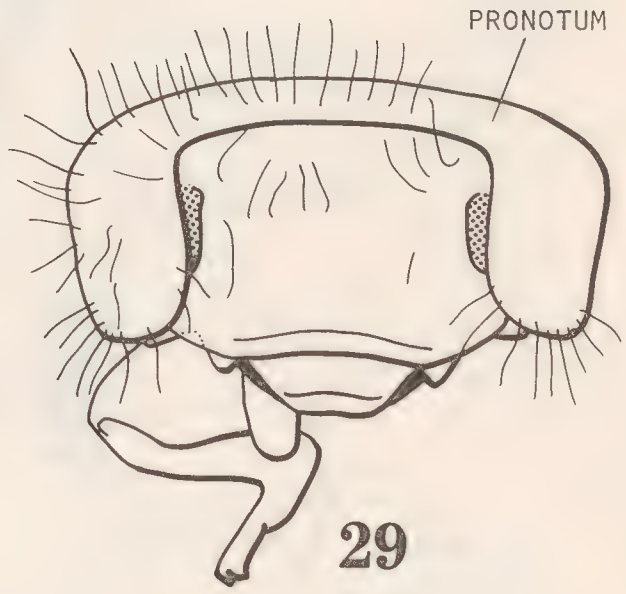

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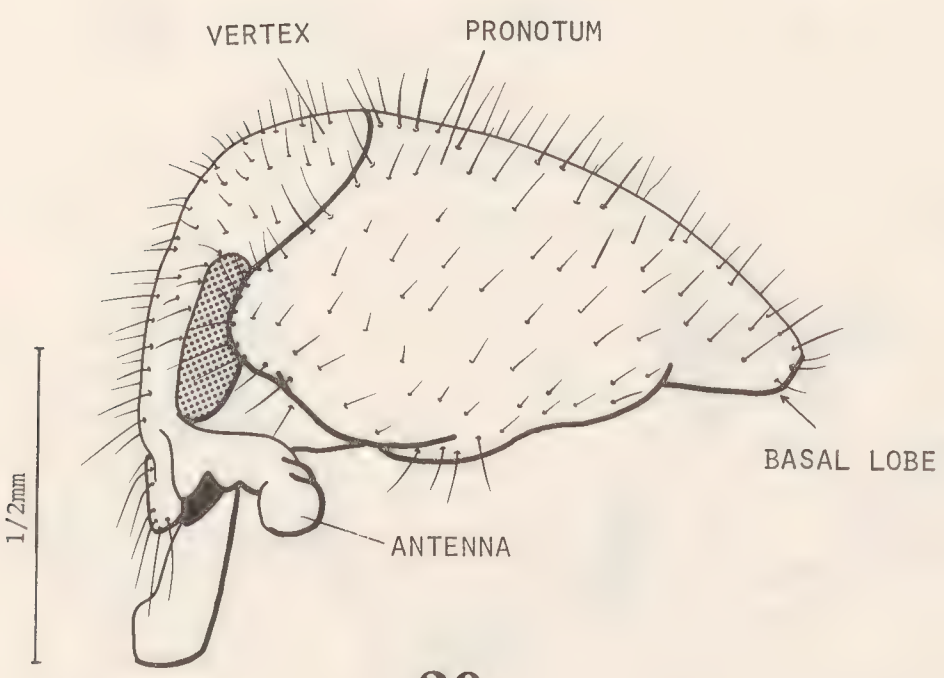

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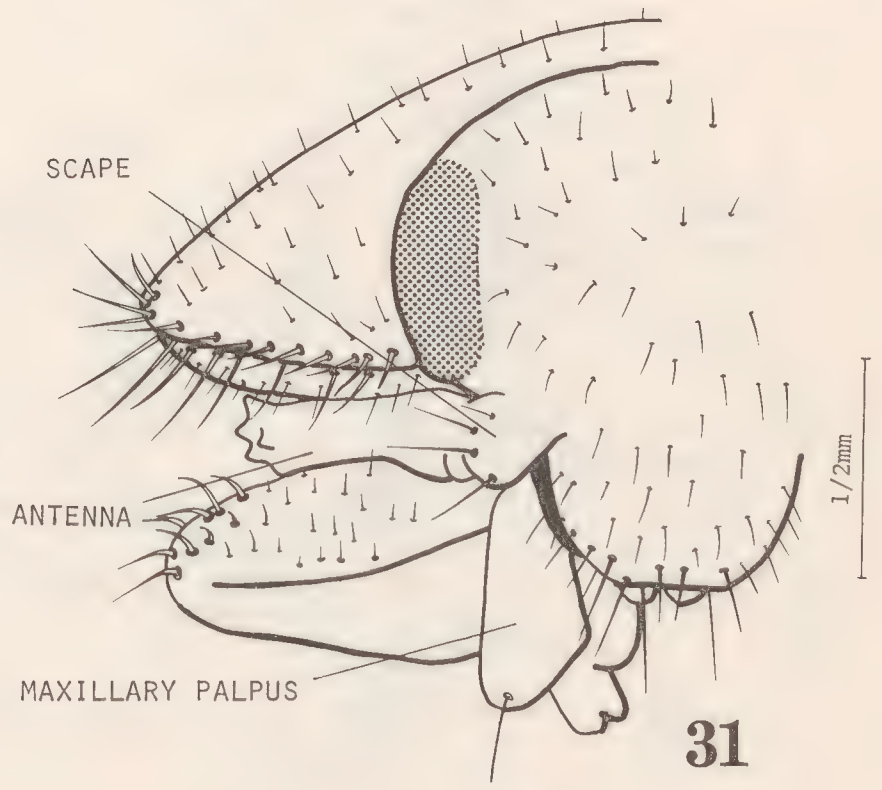

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Figs. 23-31: Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.

Fig. 23. *Chilocorus bivulnerus*

Fig. 24. *Axion platiatum*

Fig. 25. *Axion plagiatum,* a close-up portion of the surface of the pronotum.

Fig. 26. *Exochomus hoegei*

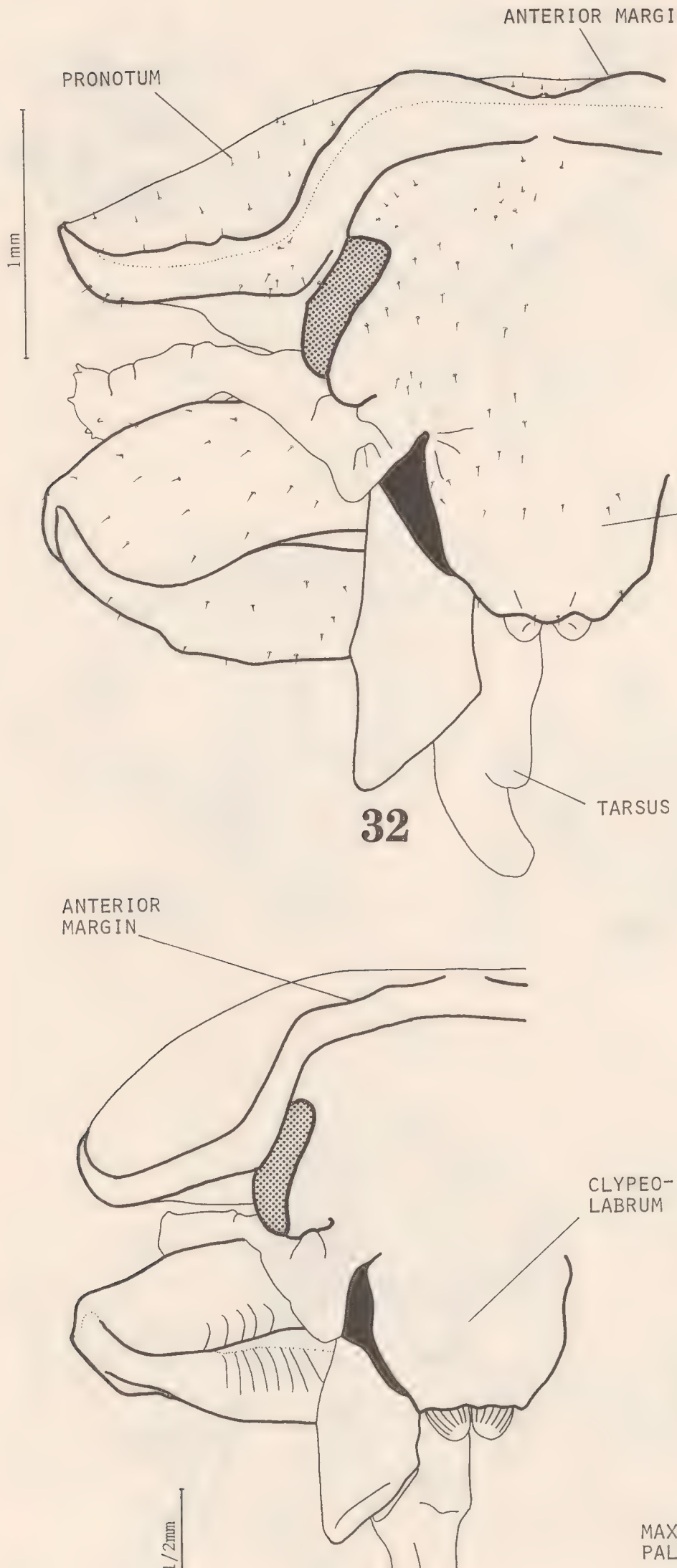
Fig. 27. *Exochomus cubensis,* clypeolabral portion.

Fig. 28. *Brumoides suturalis*

Fig. 29. *Orcus chalybeus*

Fig. 30. *Scymnus creperus,* lateral aspect.

Fig. 31. *Cryptolaemus montrouzieri*



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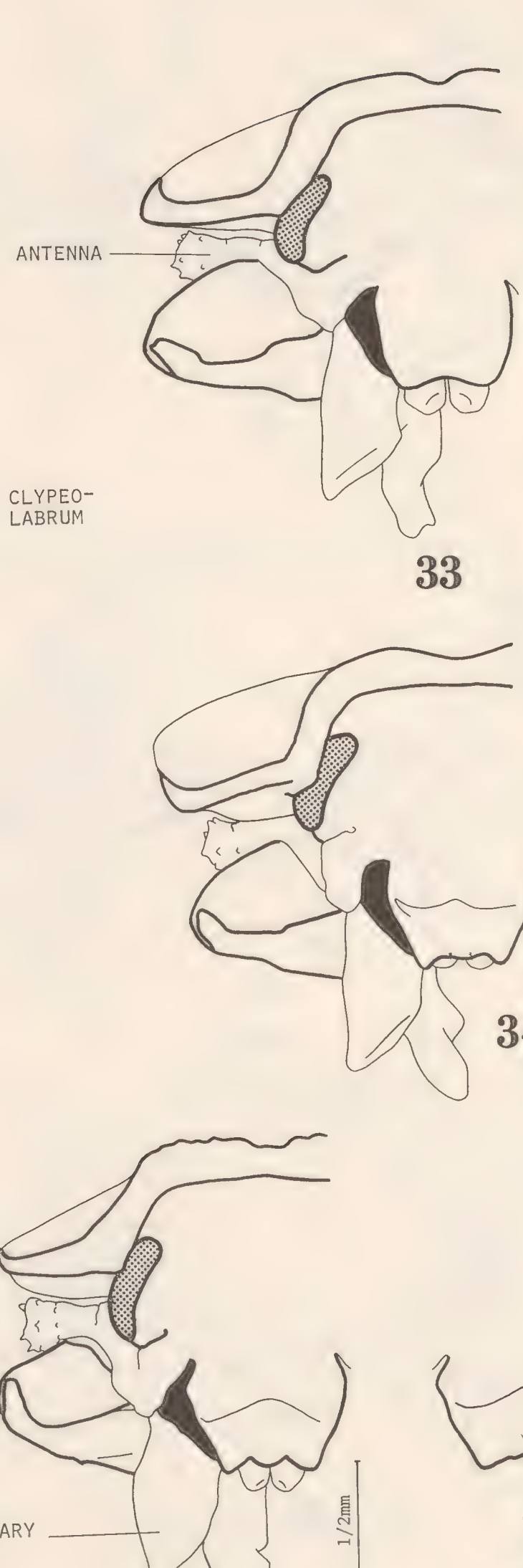

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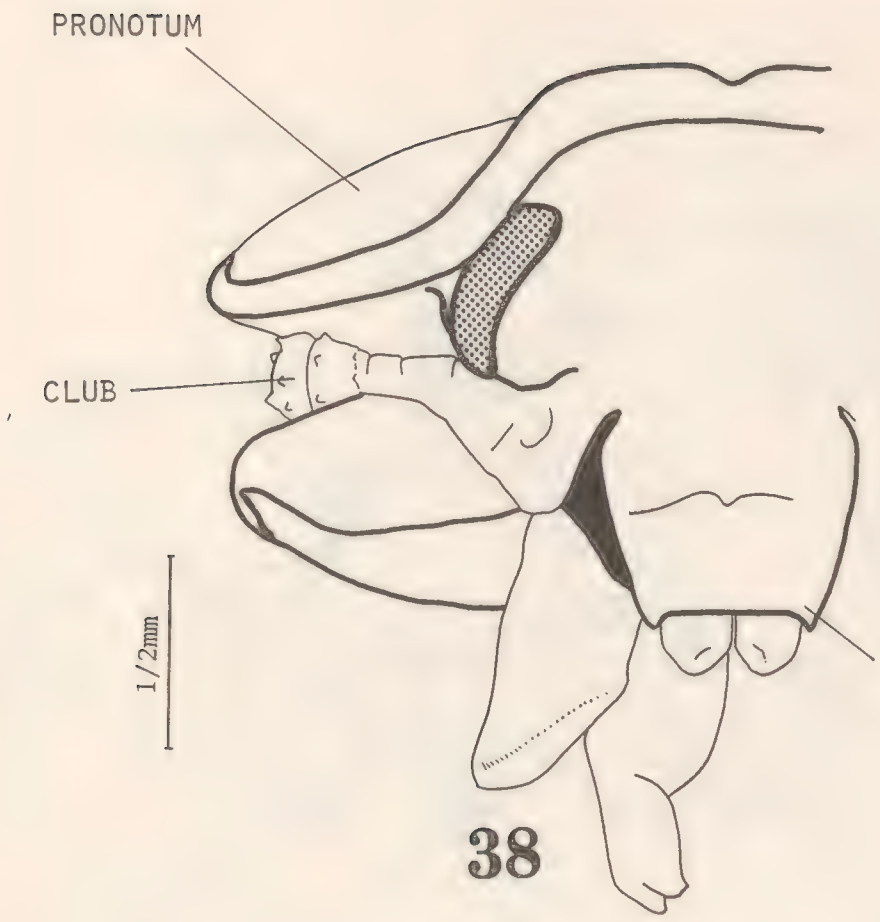
Figs. 32-37: Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.
Fig. 32 *Anatis ocellata*
Fig. 33. *Mulsantina picta*
Fig. 34. *Olla abdominalis*
Fig. 35. *Coccinella novemnotata*
Fig. 36. *Adalia bipunctata*
Fig. 37. *Adalia bipunctata*, clypeolabrum



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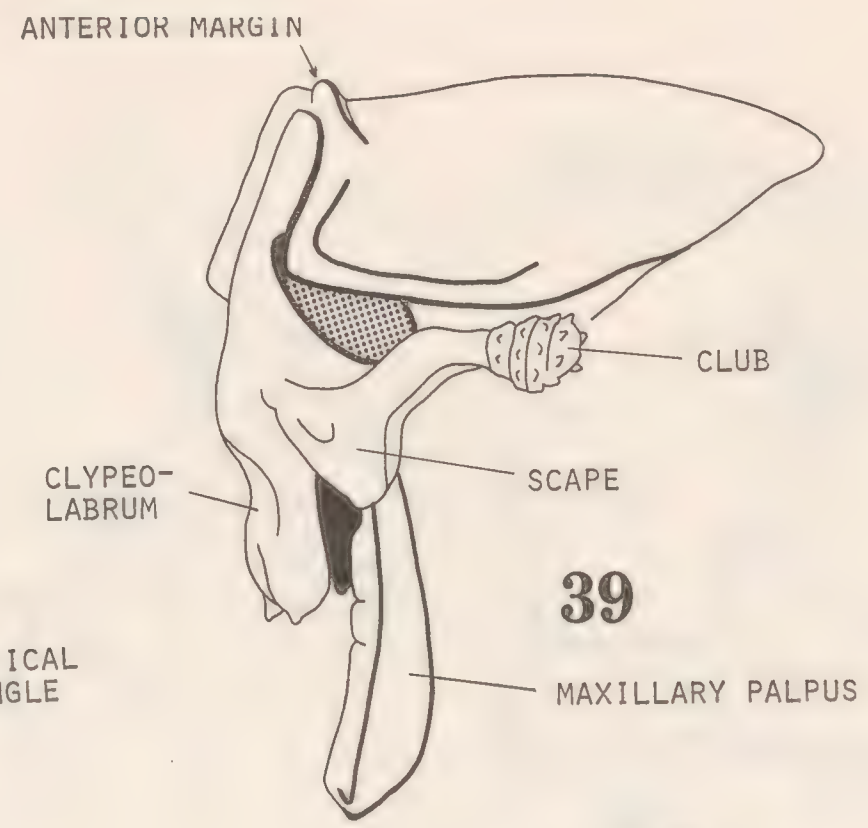

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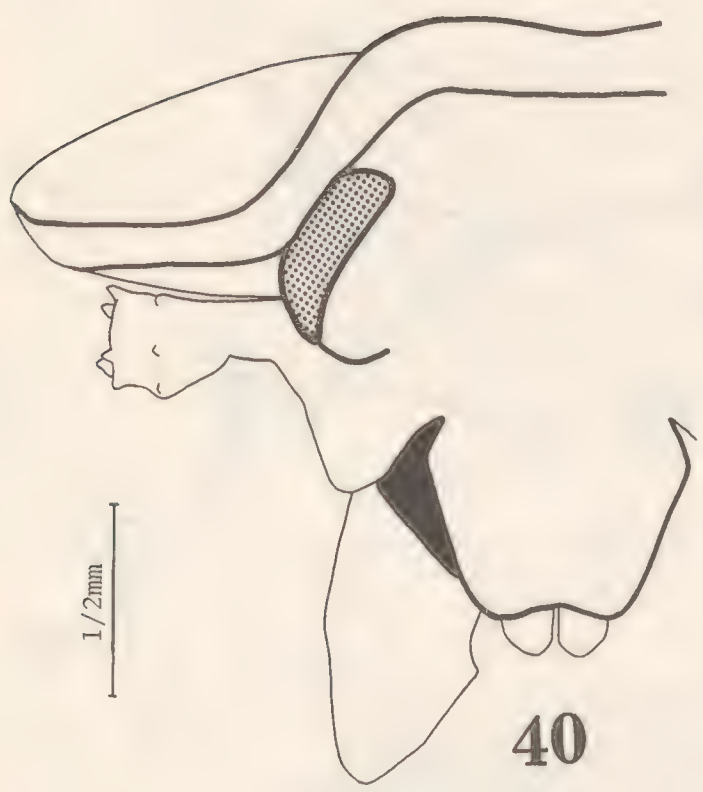

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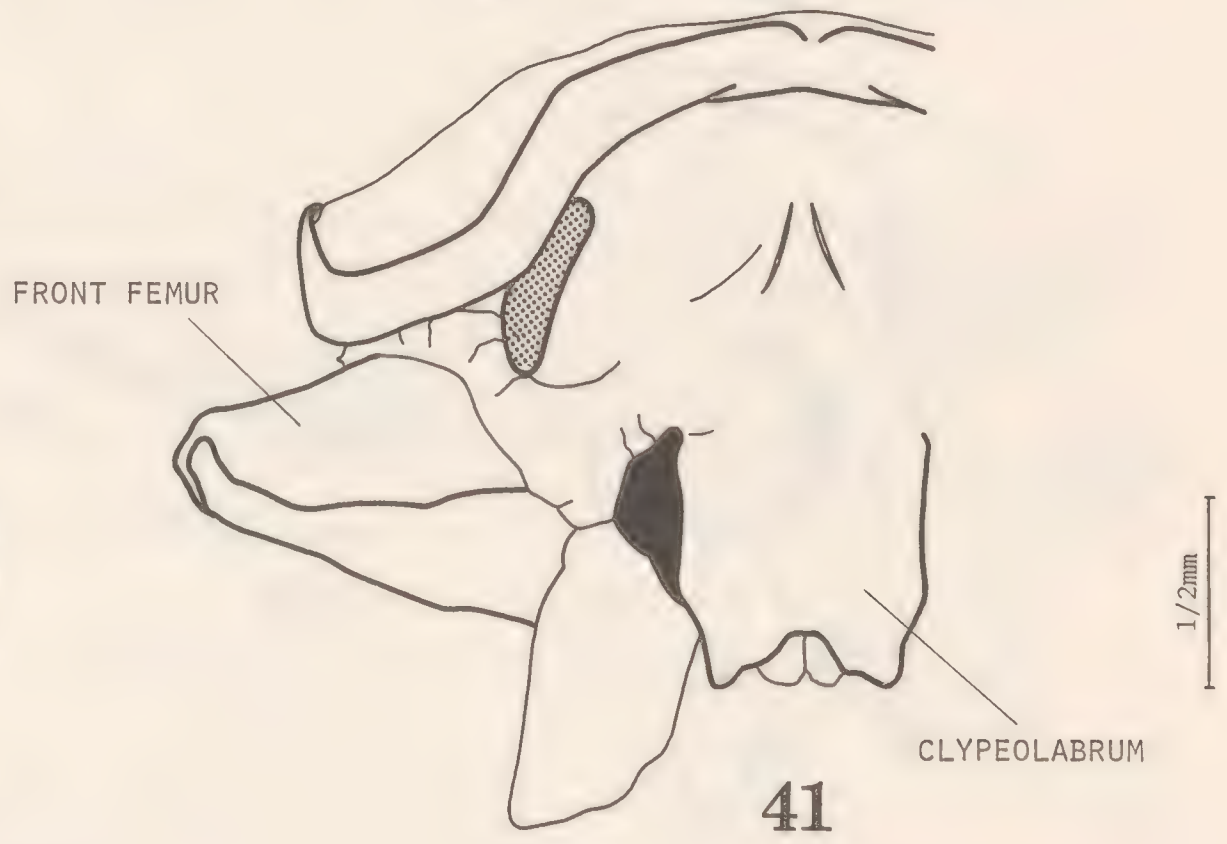

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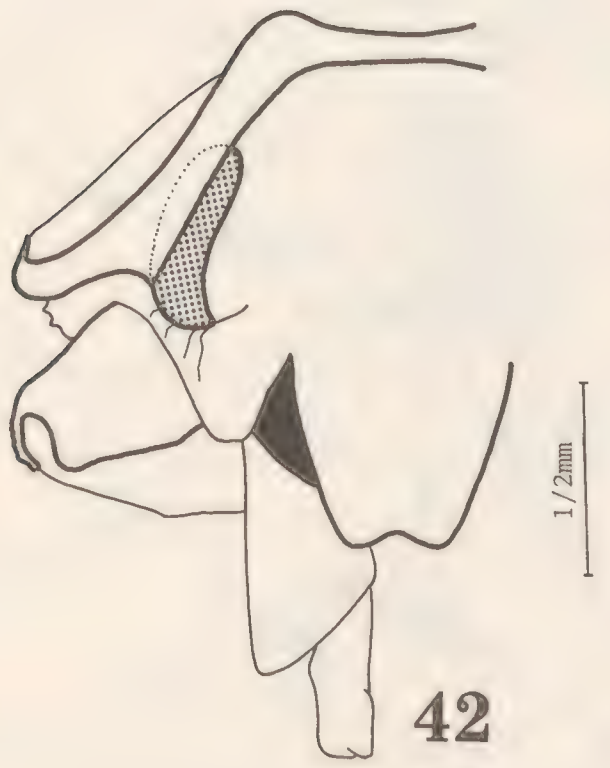

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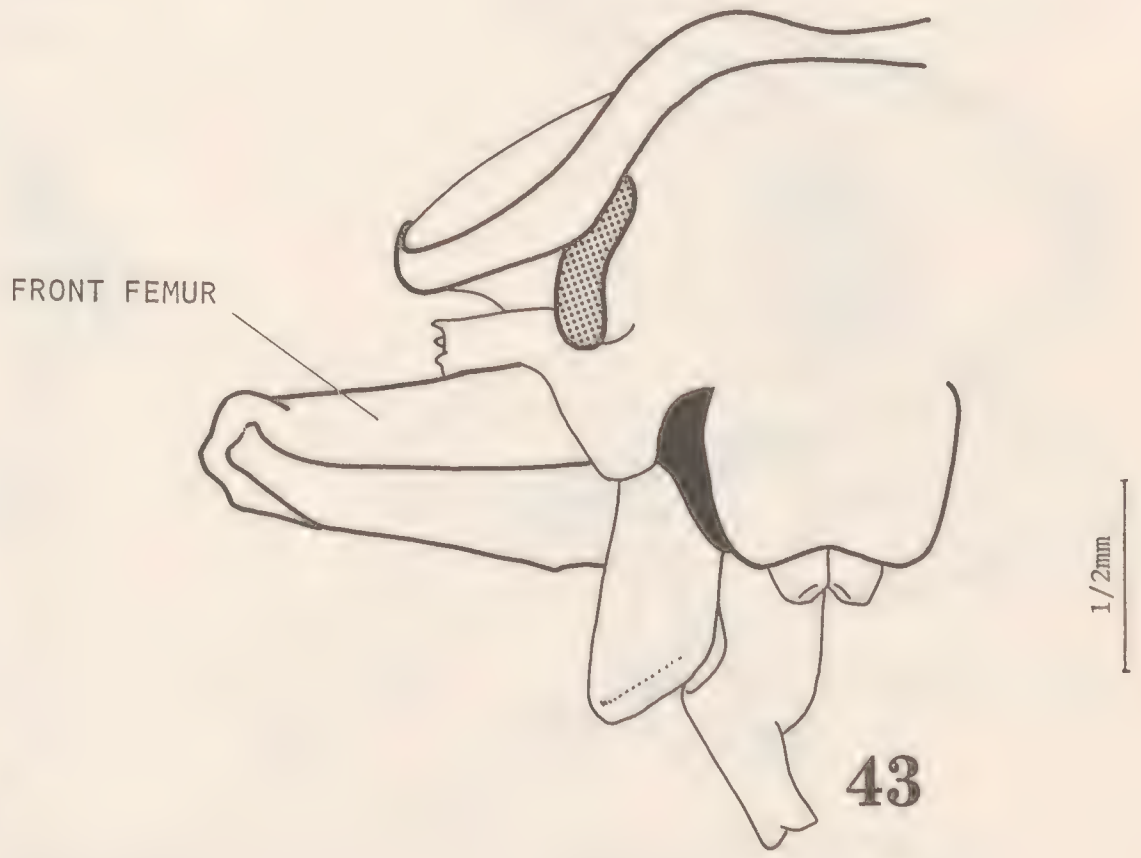

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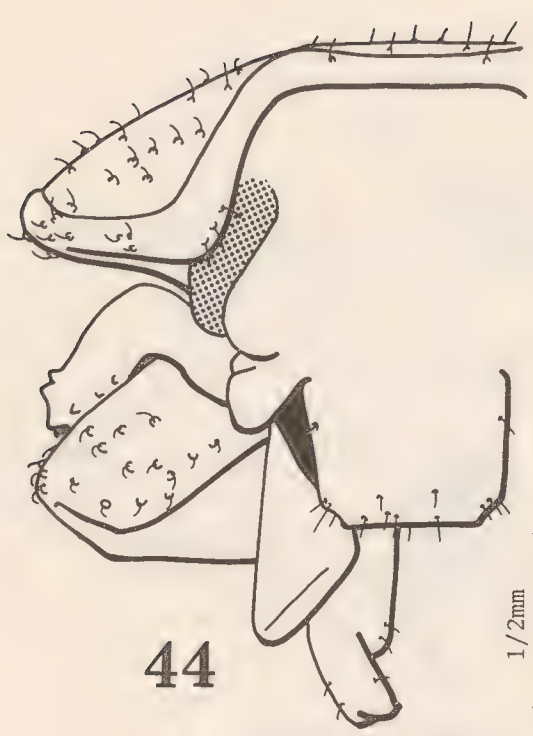
Figs. 38-43: Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.
Fig. 38. *Cycloneda munda*
Fig. 39. *Cycloneda munda* (lateral aspect)
Fig. 40. *Neoharmonia venusta*
Fig. 41. *Hippodamia convergens*
Fig. 42. *Naemia seriata*
Fig. 43. *Coleomegilla maculata*



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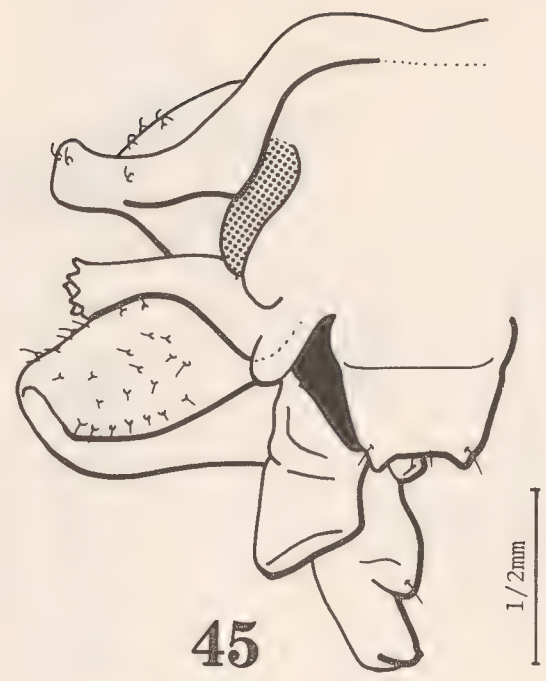

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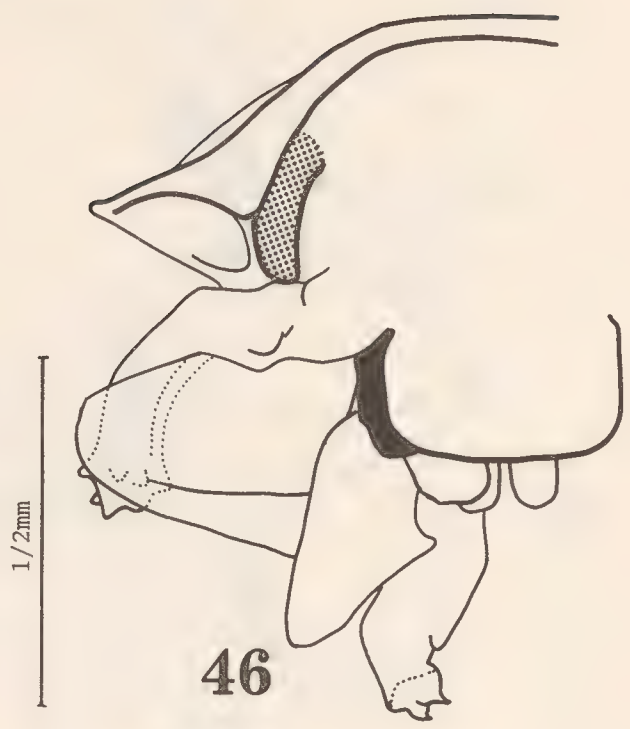

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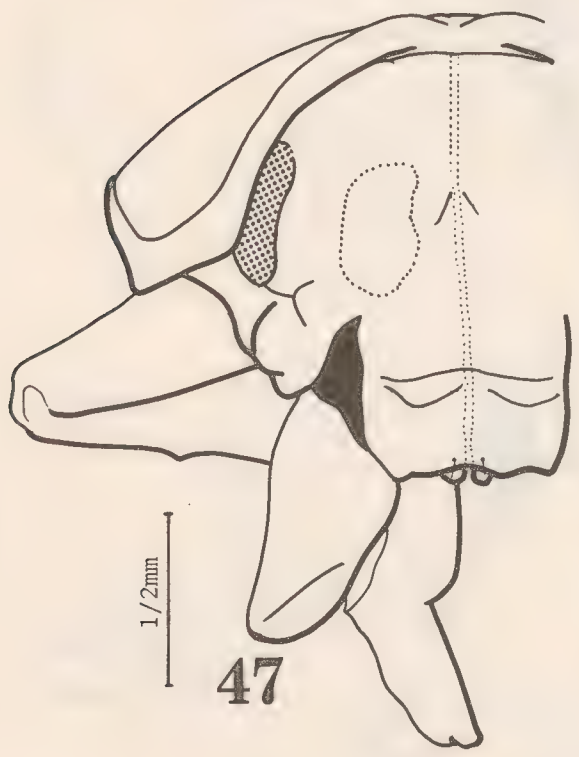

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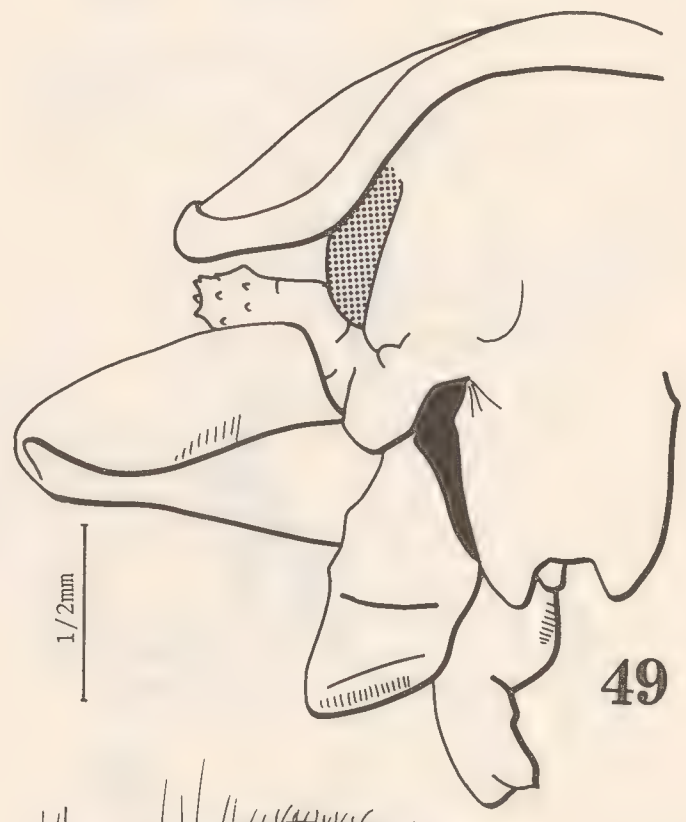

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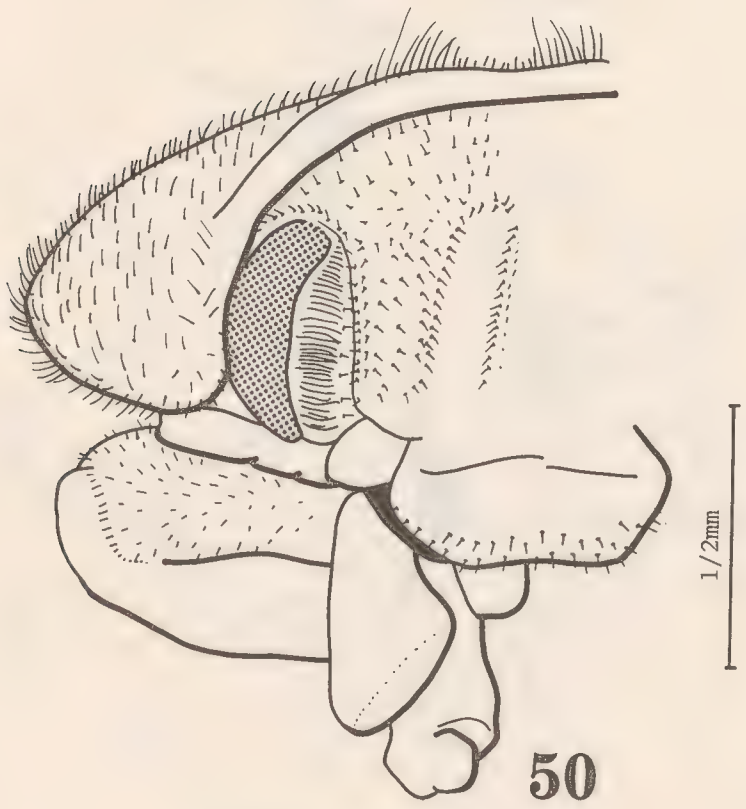

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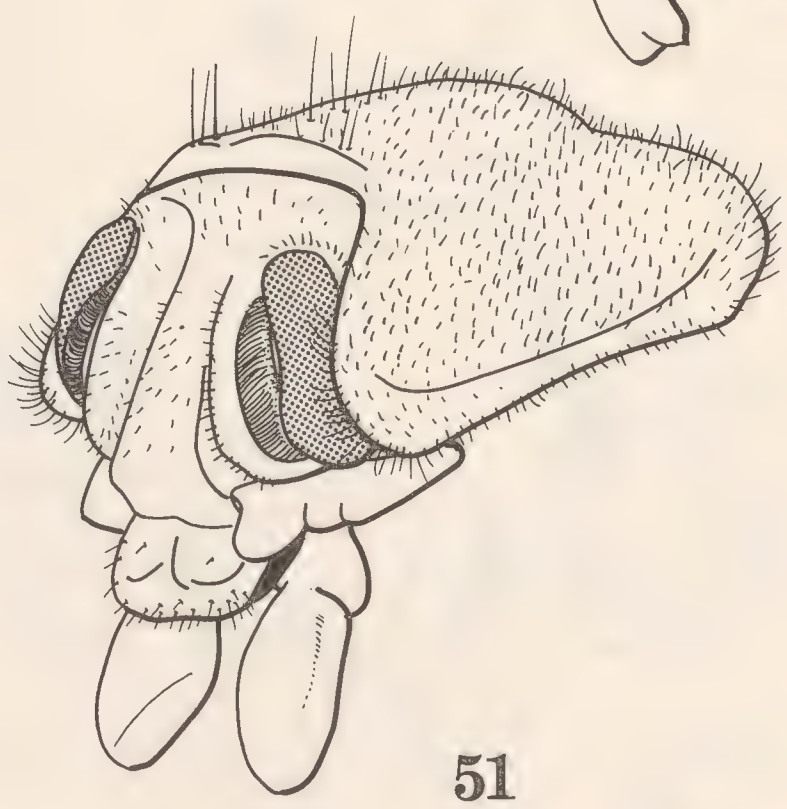

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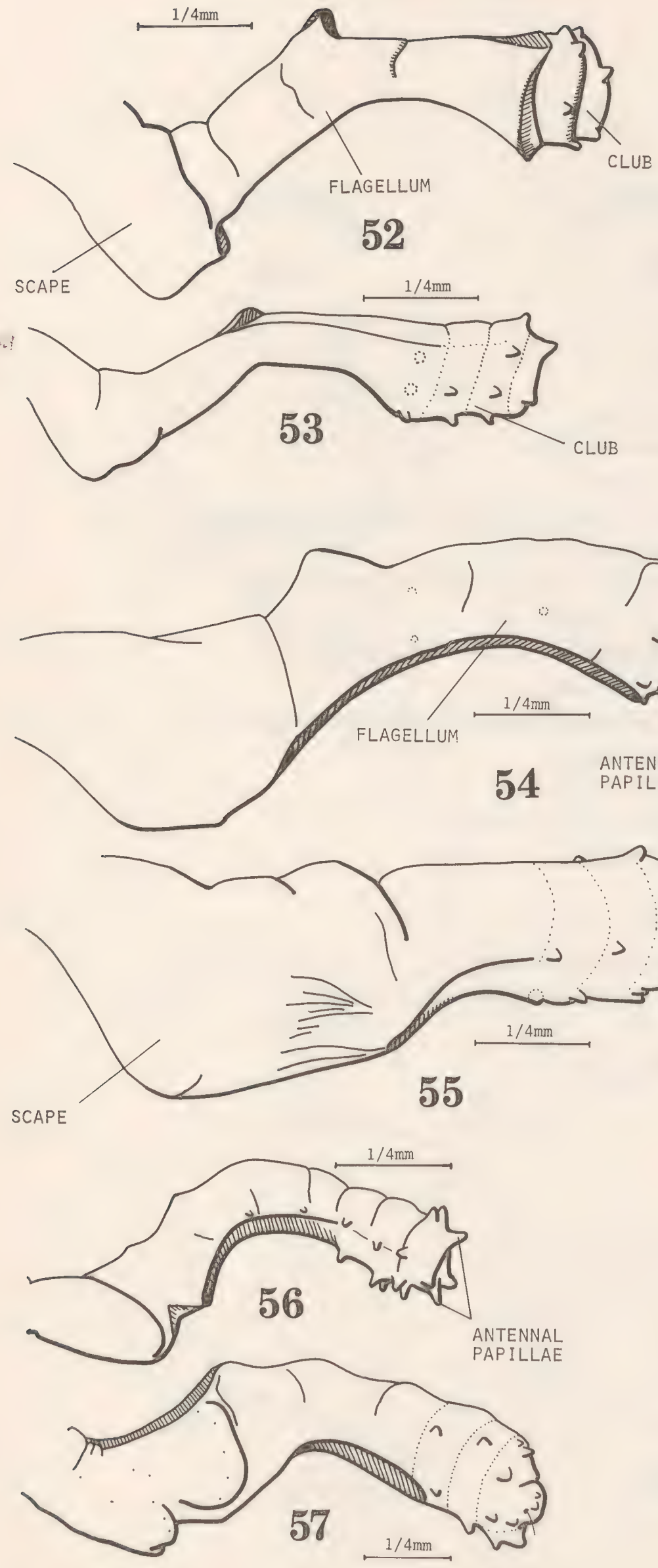
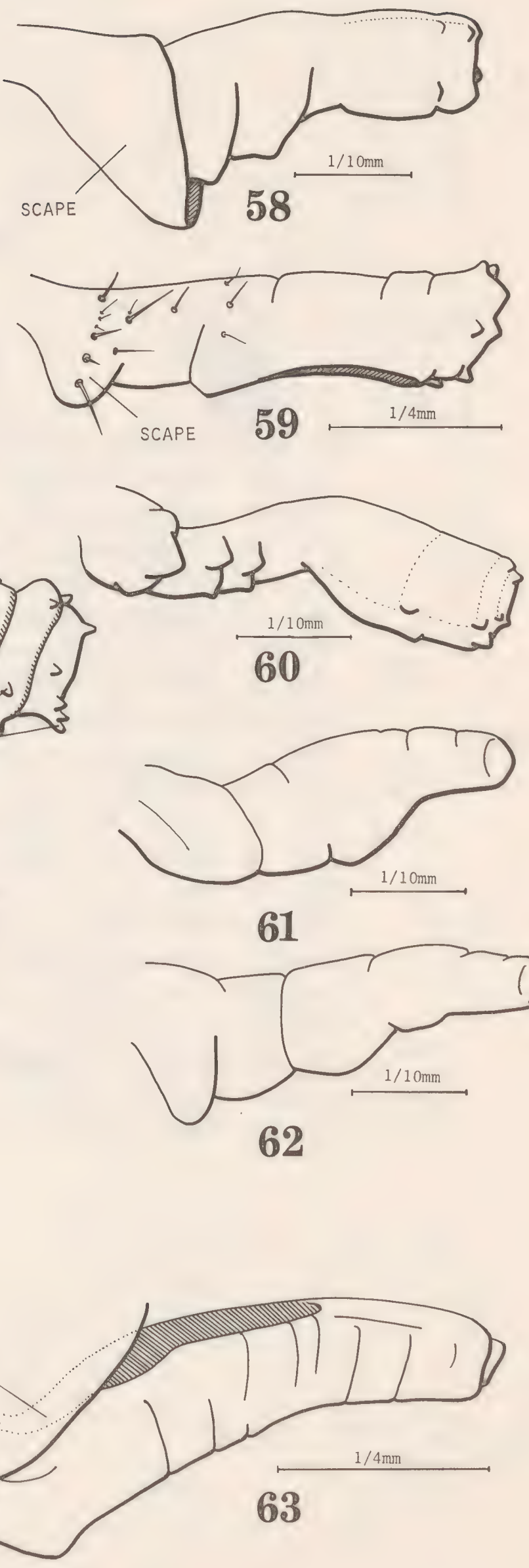
Figs. 44-51: Frontal aspect of the prothoracic and cephalic portion of coccinellid pupae.
Fig. 44. *Propylaea quatuordecimpunctata*
Fig. 45. *Anisocalvia quatuordecimguttata*
Fig. 46. *Psyllobora vigintimaculata*
Fig. 47. *Hippodamia parenthesis*
Fig. 48. *Hippodamia parenthesis*, clypeolabrum
Fig. 49. *Eriopis connexa*
Fig. 50. *Rodolia cardinalis*
Fig. 51. *Rodolia cardinalis*





Figs. 52-63: Frontal aspect of left antenna of coccinellid pupae.

Fig. 52. *Coccinella novemnotata*
Fig. 53. *Mulsantina picta*
Fig. 54. *Anatis ocellata*
Fig. 55. *Synonycha grandis*
Fig. 56. *Propylaea quatuordecimpunctata*
Fig. 57. *Epilachna borealis*
Fig. 58. *Scymnus creperus*
Fig. 59. *Cryptolaemus montrouzieri*
Fig. 60. *Delphastus pusillus*
Fig. 61. *Zagloba ornata*
Fig. 62. *Hyperaspis binotata*
Fig. 63. *Axion plagiatum*

Figs. 64-78: Left mandible of coccinellid pupae.
Fig. 64. *Axion plagiatum,* dorsal aspect.
Fig. 65. *Axion plagiatum,* mandibular apex as viewed from the top.
Fig. 66. *Chilocorus bivulnerus,* mandibular aspect.
Fig. 67. *Chilocorus bivulnerus,* mandibular apex as viewed from the top.
Fig. 68. *Hyperaspis binotata,* dorsal aspect.
Fig. 69. *Hyperaspis binotata,* mandibular apex as viewed from the top.
Fig. 70. *Chilocorus bivulnerus,* dorsal aspect.
Fig. 71. *Coccinella novemnotata* mandibular apex as viewed from the top.
Fig. 72. *Epilachna varivestis,* dorsal aspect.
Fig. 73. *Epilachna varivestis,* mesal aspect.
Fig. 74. *Epilachna varivestis,* viewed from the top.
Fig. 75. *Epilachna borealis,* dorsal aspect.
Fig. 76. *Epilachna sp.,* dorsal aspect.
Fig. 77. *Epilachna sp.,* viewed from the top.
Fig. 78. *Epilachna borealis,* viewed from the top.
Figs. 79-82: Left galea of coccinellid pupae as viewed from the top.
Fig. 79. *Anatis ocellata*
Fig. 80. *Mulsantina picta*
Fig. 81. *Cycloneda munda*
Fig. 82. *Adalia bipunctata*

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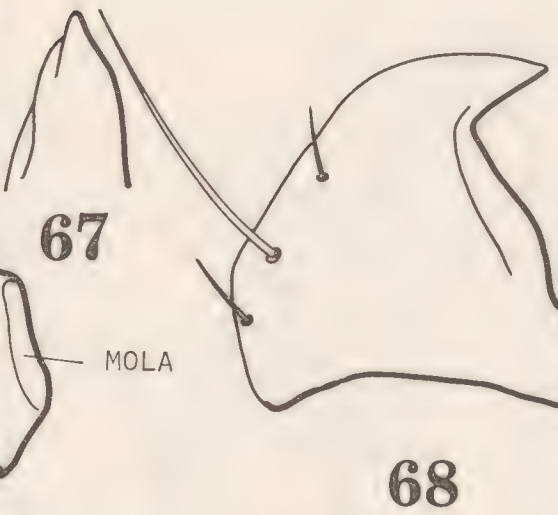
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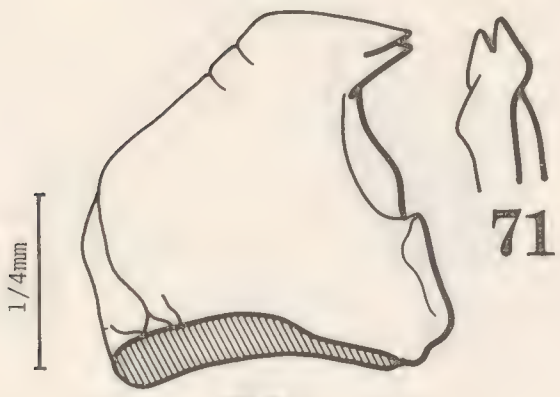

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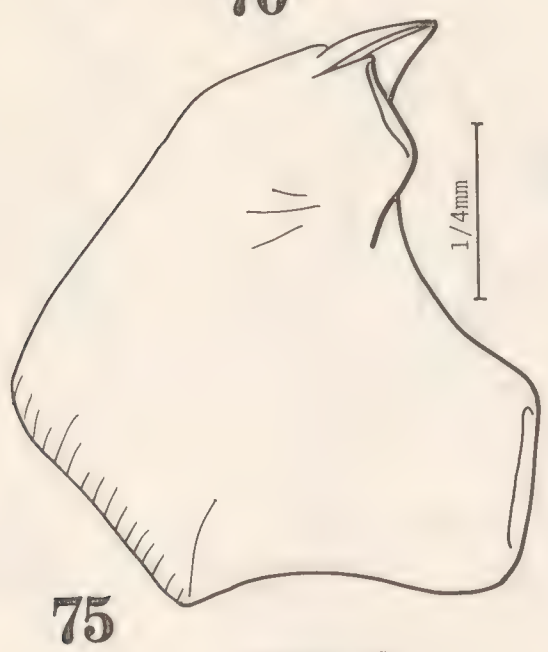

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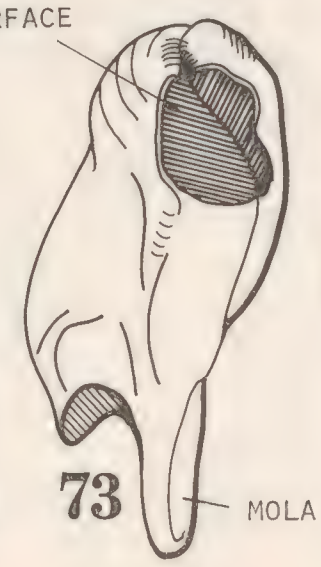

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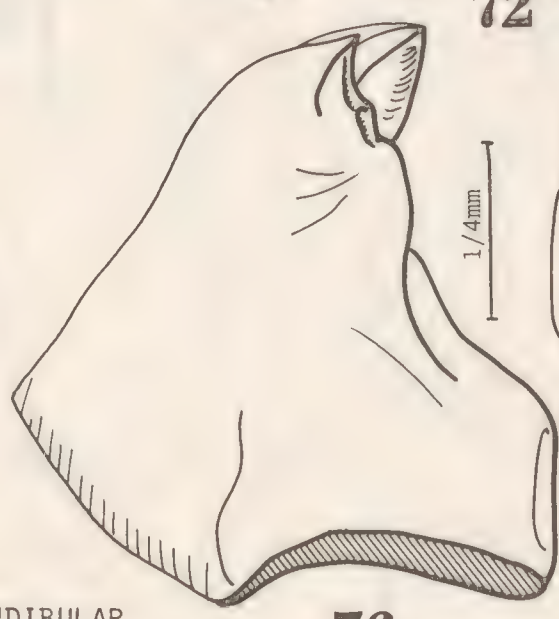

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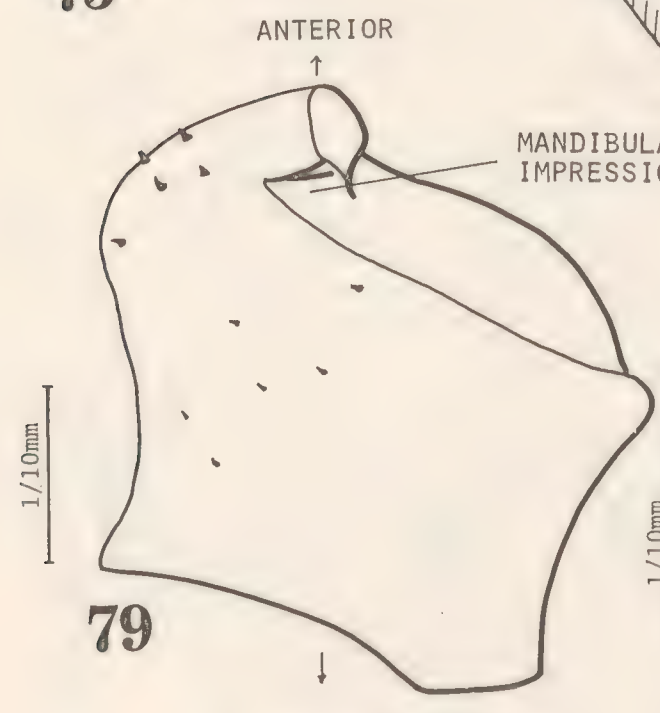

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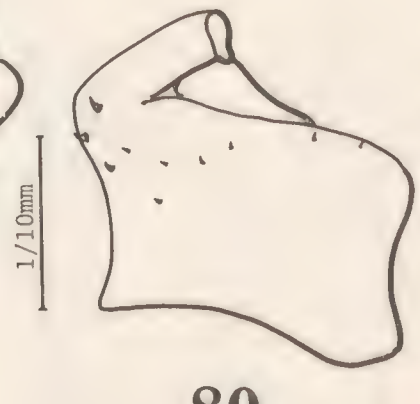

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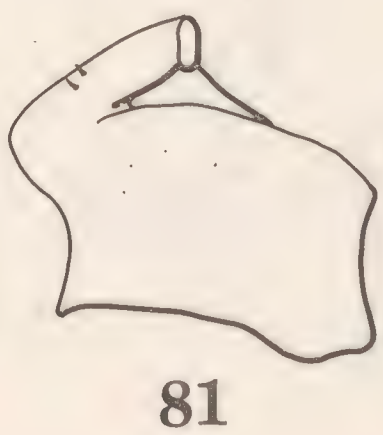
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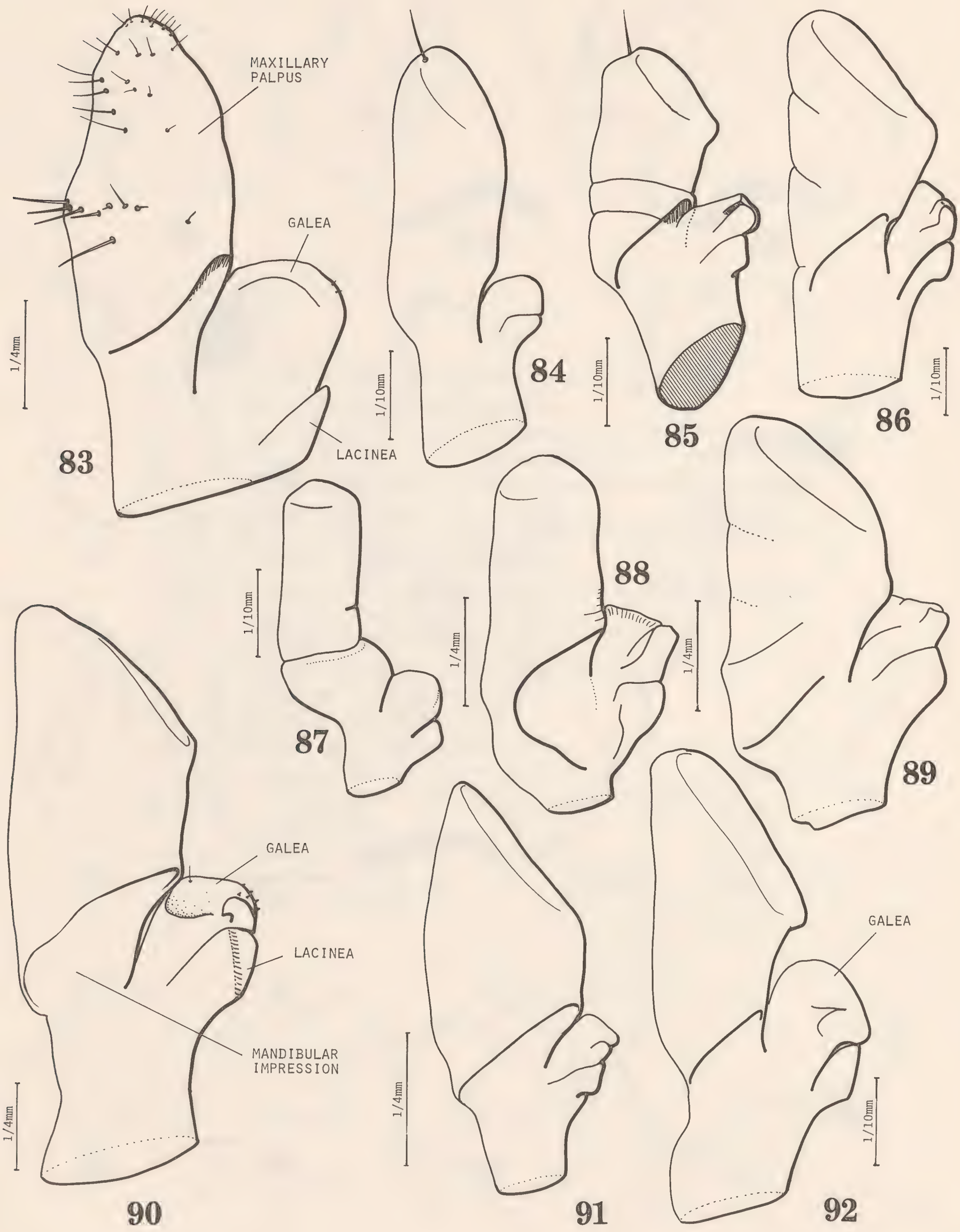
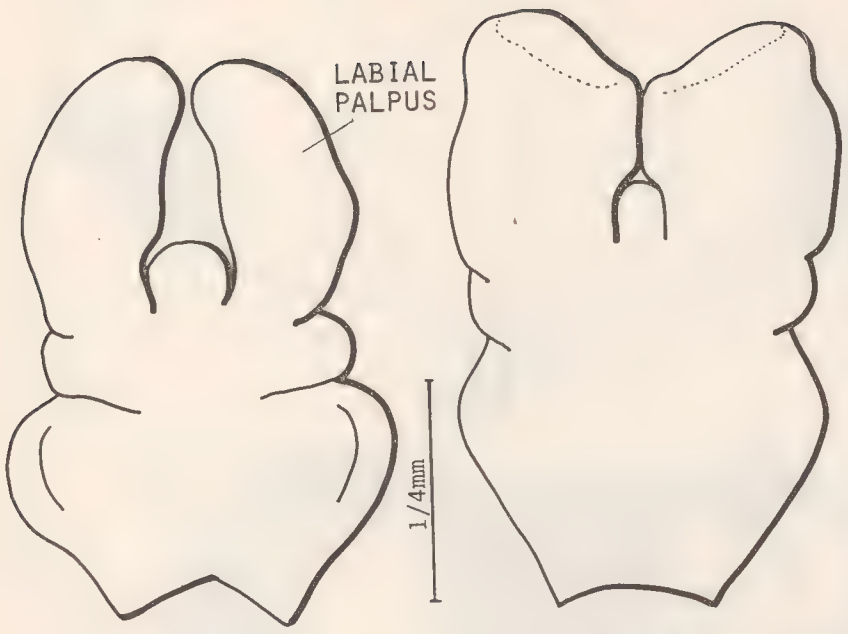


Figs. 83-92: Dorsal aspect of the maxilla of coccinellid pupae.

Fig. 83. *Epilachna varivestis*
Fig. 84. *Zagloba ornata*
Fig. 85. *Cryptolaemus montrouzieri*
Fig. 86. *Hyperaspis binotata*
Fig. 87. *Delphastus pusillus*
Fig. 88. *Chilocorus bivulnerus*
Fig. 89. *Axion plagiatum*
Fig. 90. *Anatis ocellata*
Fig. 91. *Adalia bipunctata*
Fig. 92. *Psyllobora vigintimaculata*



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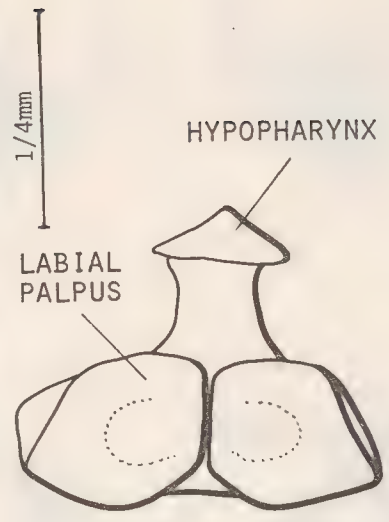

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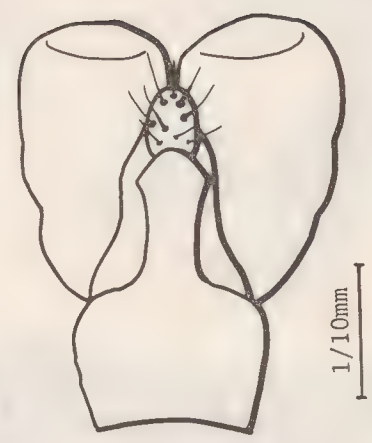

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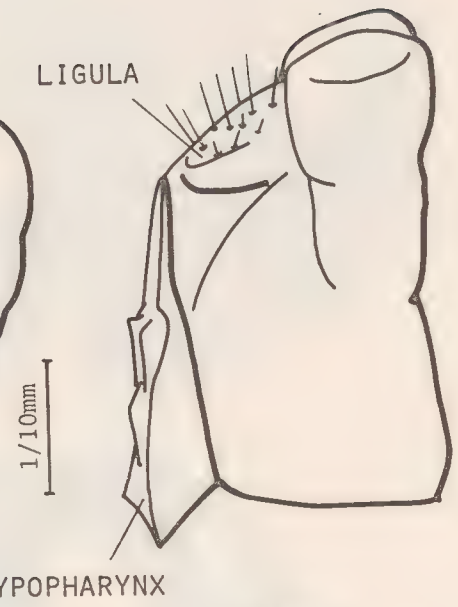

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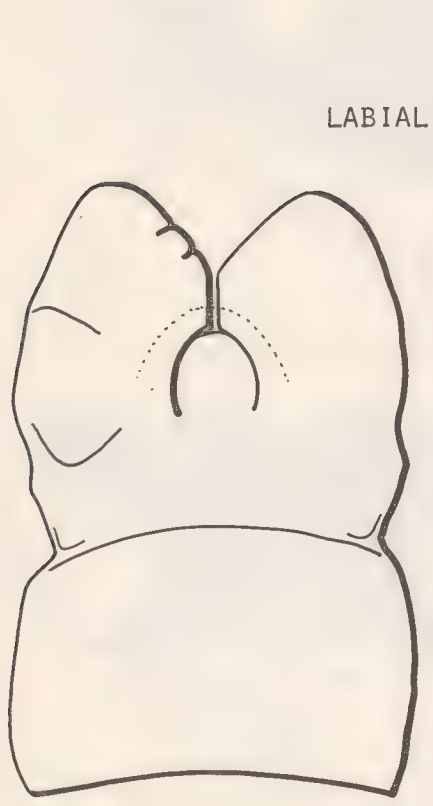

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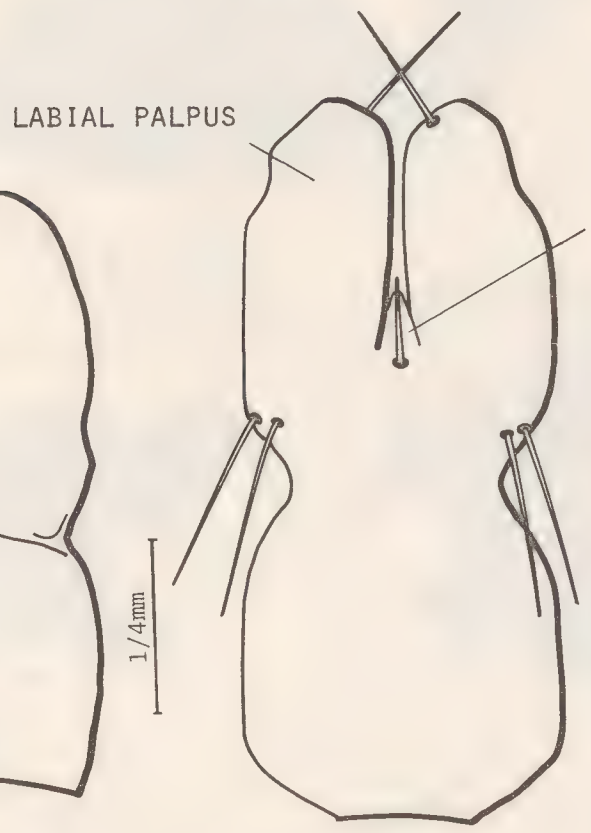

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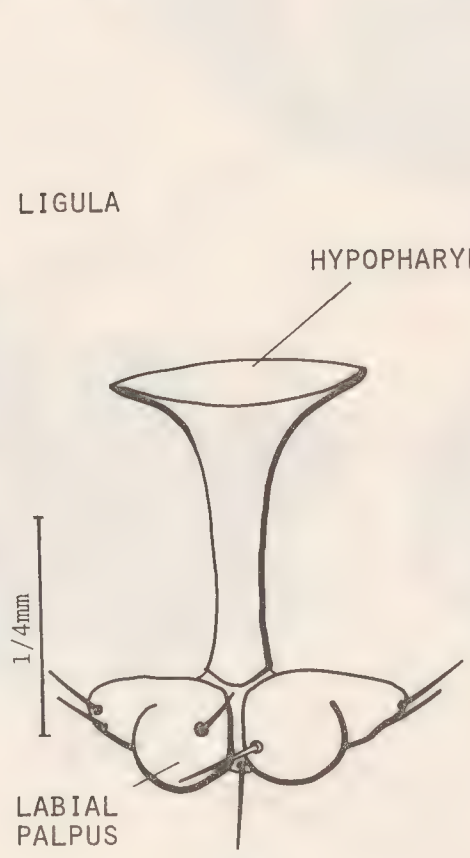

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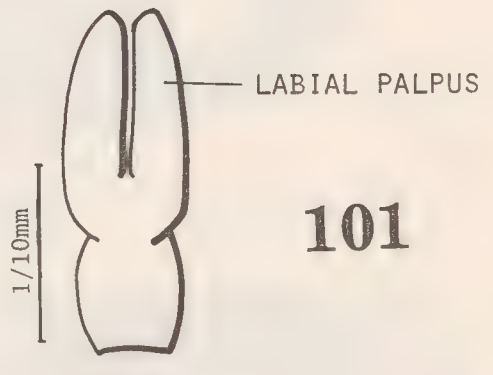

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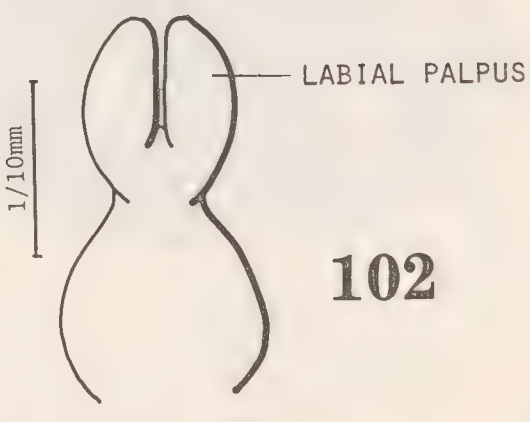

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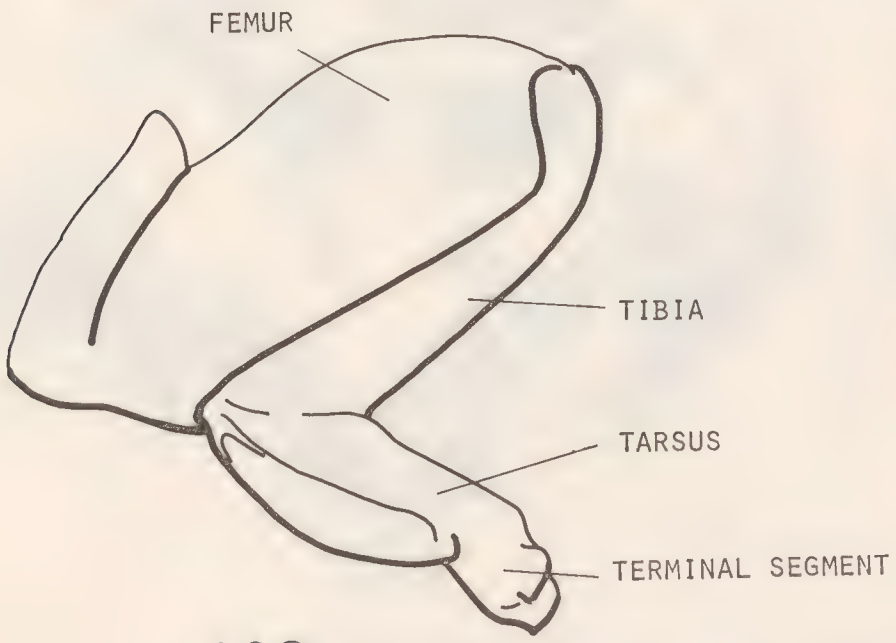

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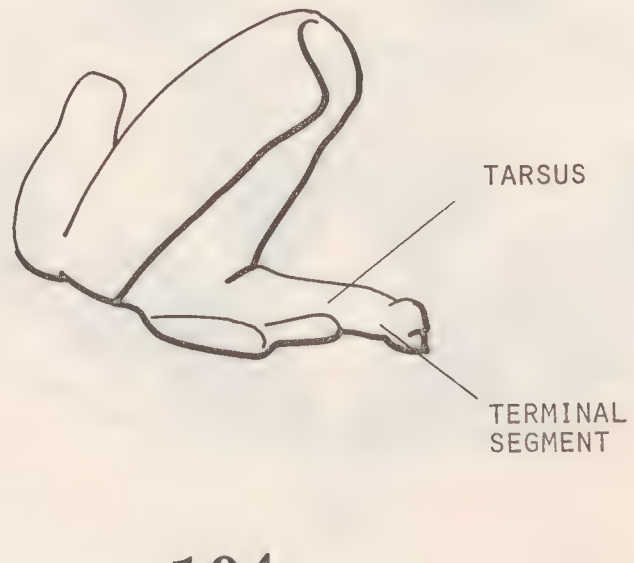

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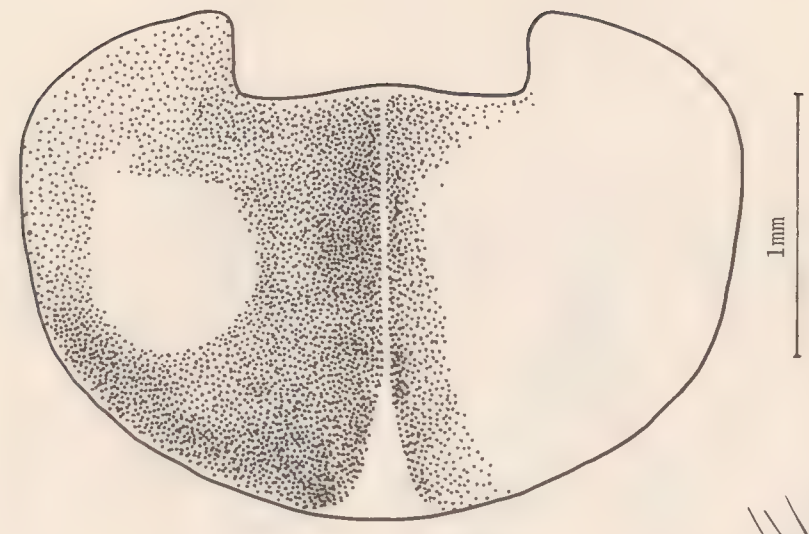
Figs. 93-102: Labium of coccinellid pupae.
- Fig. 93. *Chilocorus bivulnerus,* ventral aspect.
- Fig. 94. *Axion plagiatum,* ventral aspect.
- Fig. 95. *Axion plagiatum,* viewed from the apex.
- Fig. 96. *Hyperaspis binotata,* dorsal aspect.
- Fig. 97. *Hyperaspis binotata,* lateral aspect.
- Fig. 98. *Anatis ocellata,* ventral aspect.
- Fig. 99. *Epilachna varivestis,* ventral aspect.
- Fig. 100. *Epilachna varivestis,* viewed from the top.
- Fig. 101. *Delphastus pusillus,* ventral aspect.
- Fig. 102. *Zagloba ornata,* ventral aspect.

Figs. 103-104: Hind legs.
- Fig. 103. *Axion plagiatum*
- Fig. 104. *Brumoides suturalis*



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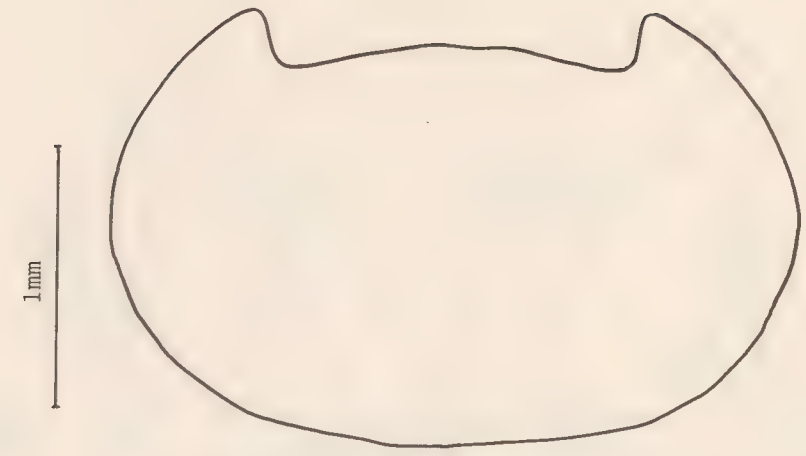

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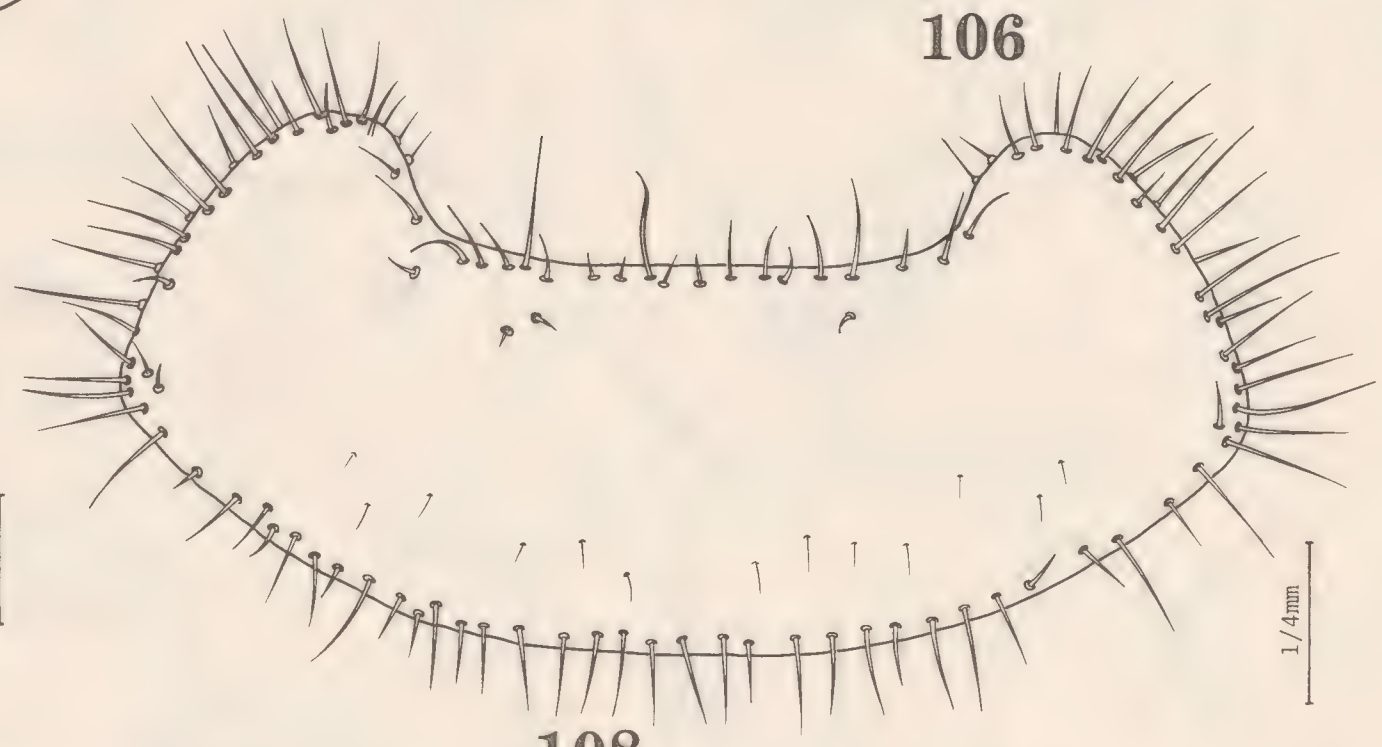

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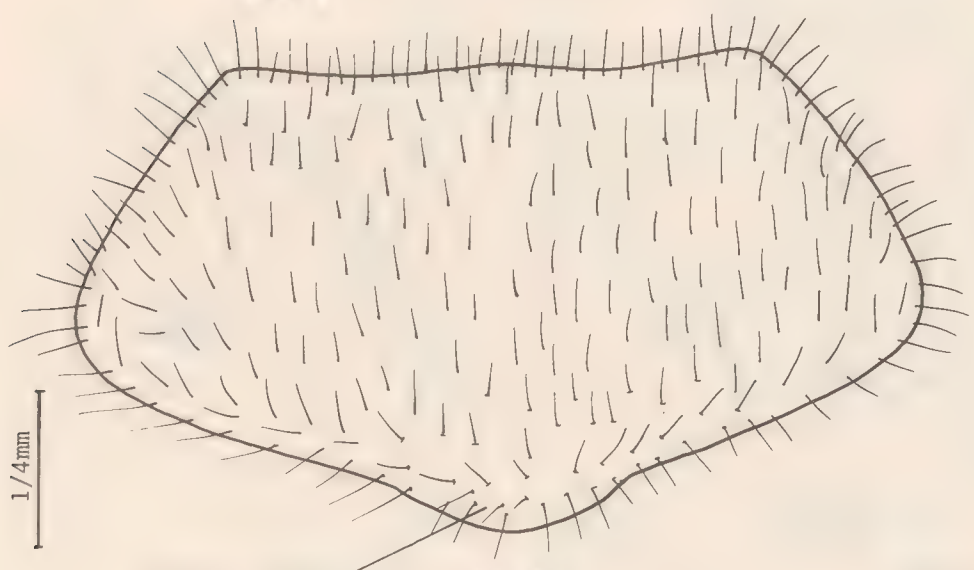

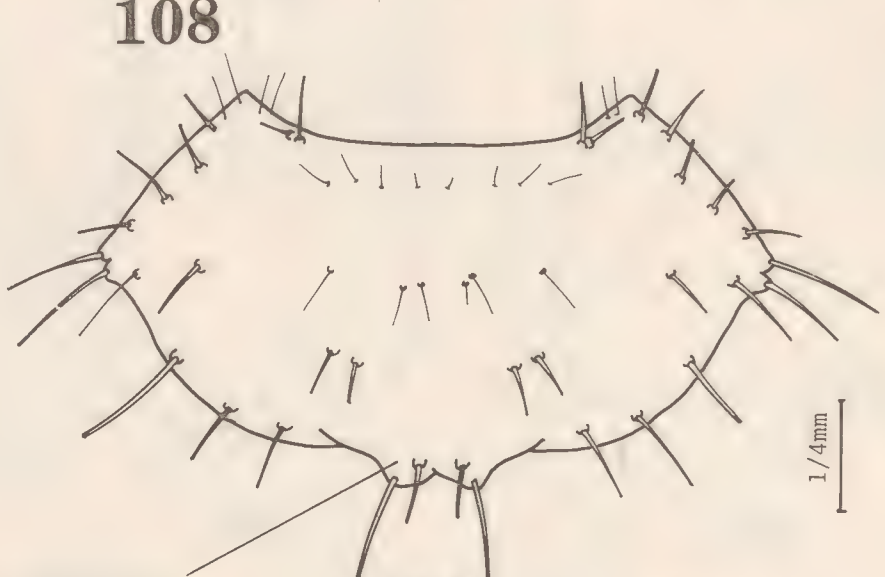

BASAL LOBE

BASAL TUBERCLES

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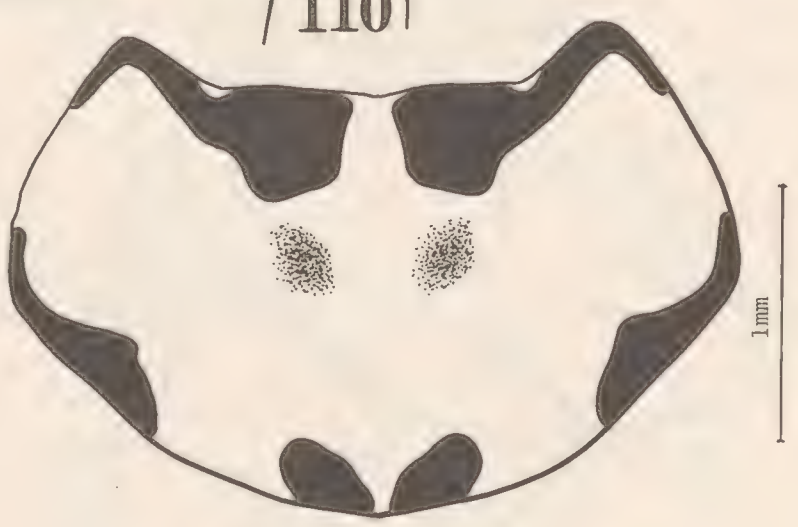

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Figs. 105-112: Dorsal aspect of the pronotum of coccinellid pupae.

Fig. 105. *Axion plagiatum*
Fig. 106. *Exochomus hoegei*
Fig. 107. *Brumoides suturalis*
Fig. 108. *Epilachna varivestis*
Fig. 109. *Scymnus creperus*
Fig. 110. *Stethorus atomus*
Fig. 111. *Neoharmonia venusta*
Fig. 112. *Coccinella trifasciata*

Figs. 113-121: Dorsal aspect of the pronotum of coccinellid pupae.
Fig. 113. *Coccinella transversoguttata*
Fig. 114. *Coccinella transversoguttata*
Fig. 115. *Coccinella monticola*
Fig. 116. *Coccinella monticola*
Fig. 117. *Adalia bipunctata*
Fig. 118. *Adalia bipunctata*
Fig. 119. *Adalia bipunctata*
Fig. 120. *Anatis ocellata*
Fig. 121. *Anatis quindecimpunctata*

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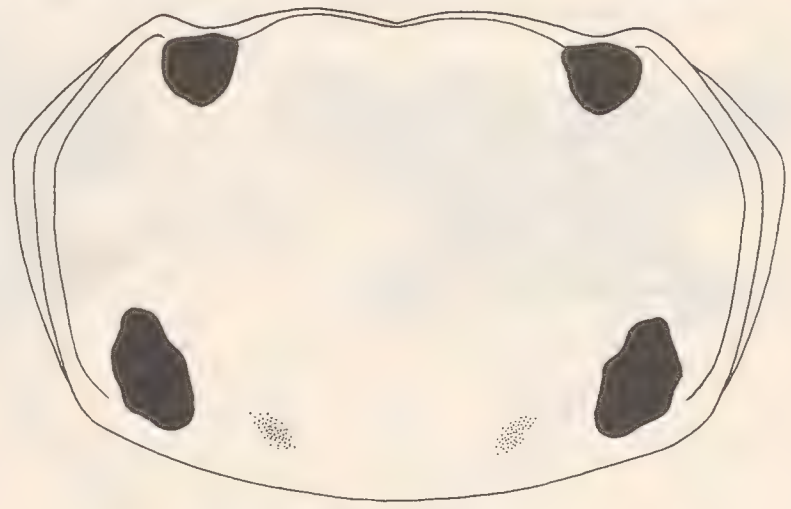

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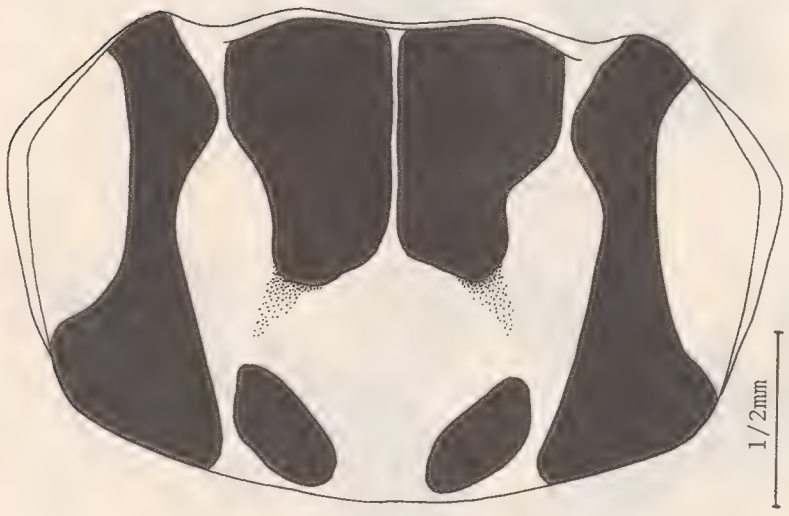

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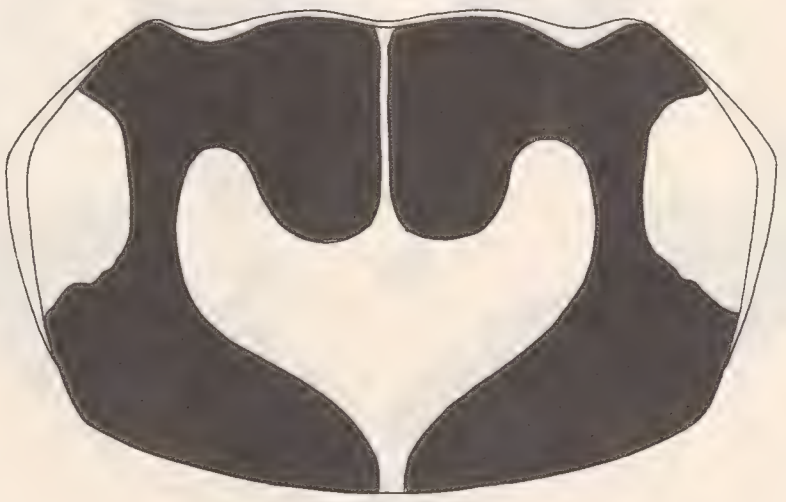

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Figs. 122-130: Dorsal aspect of the pronotum of coccinellid pupae.

Fig. 122. *Mulsantina picta*
Fig. 123. *Mulsantina hudsonica*
Fig. 124. *Coleomegilla maculata*
Fig. 125. *Coleomegilla maculata*
Fig. 126. *Coleomegilla maculata,* lateral aspect.
Fig. 127. *Eriopis connexa*
Fig. 128. *Hippodamia tredecimpunctata,* light form.
Fig. 129. *Hippodamia tredecimpunctata,* dark form.
Fig. 130. *Hippodamia tredecimpunctata,* dark form.

Figs. 131-138: Dorsal aspect of the pronotum of coccinellid pupae.
Fig. 131. *Hippodamia parenthesis*
Fig. 132. *Hippodamia parenthesis*
Fig. 133. *Hippodamia parenthesis,* cross section of lateral margin of the pronotum.
Fig. 134. *Hippodamia parenthesis*
Fig. 135. *Hippodamia quinquesignata*
Fig. 136. *Hippodamia convergens*
Fig. 137. *Hippodamia convergens*
Fig. 138. *Olla abdominalis*
Figs. 139-140: Dorsal aspect of the metanotum of coccinellid pupae.
Fig. 139. *Mulsantina picta*
Fig. 140. *Mulsantina hudsonica*

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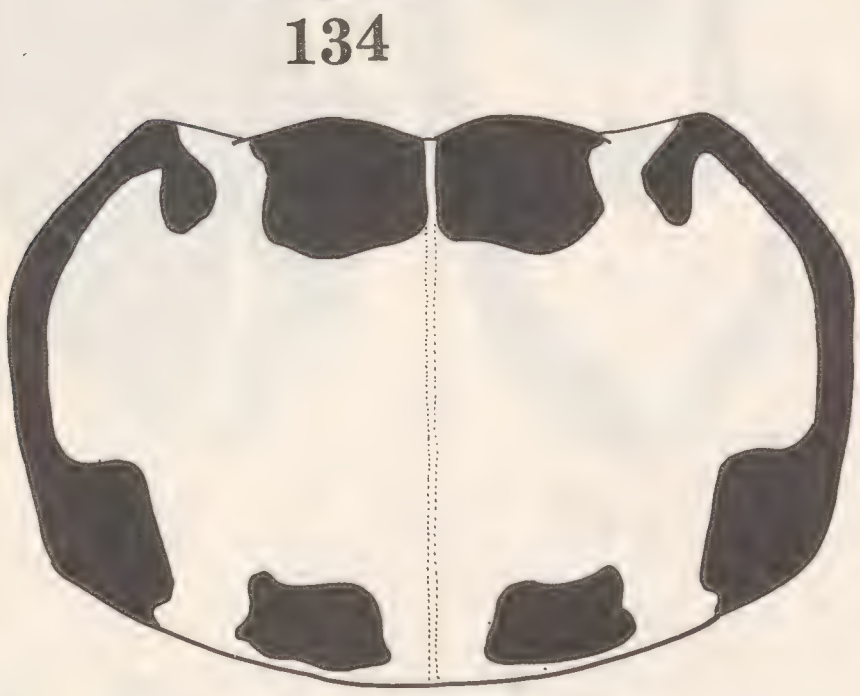

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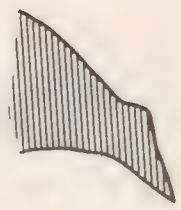

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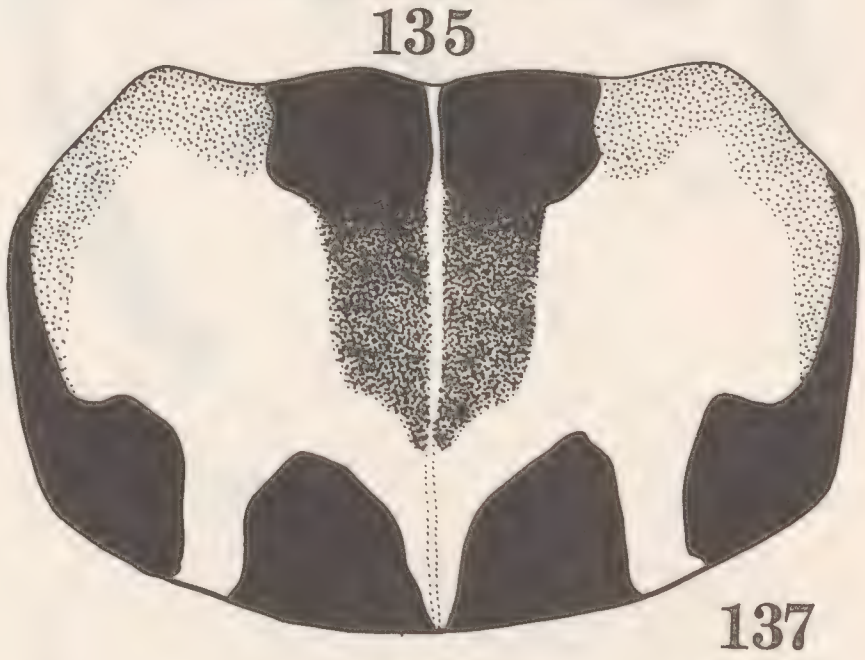

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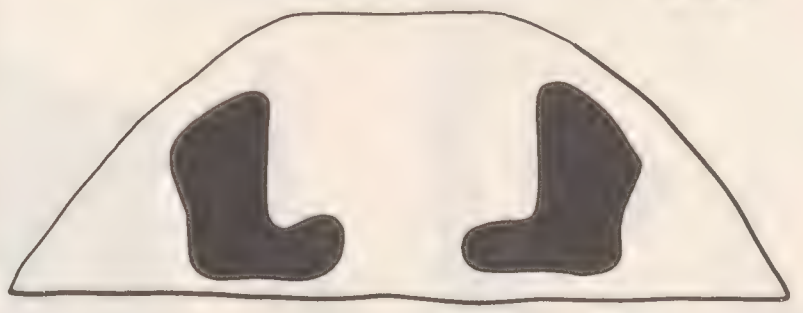

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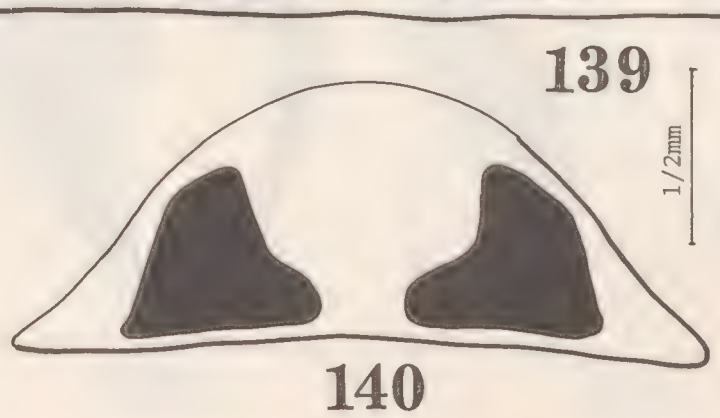

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Figs. 141-152: Dorsal aspect of left elytron of coccinellid pupae.

Fig. 141. *Coccinella trifasciata*
Fig. 142. *Coccinella trifasciata*
Fig. 143. *Coccinella septempunctata*
Fig. 144. *Coccinella septempunctata,* dark form.
Fig. 145. *Coccinella transversoguttata*
Fig. 146. *Coccinella transversoguttata*
Fig. 147. *Coccinella transversoguttata*
Fig. 148. *Coccinella transversoguttata,* dark form.
Fig. 149. *Coccinella novemnotata*
Fig. 150. *Coccinella novemnotata*
Fig. 151. *Coccinella novemnotata,* dark form.
Fig. 152. *Coccinella monticola*

Figs. 153-163: Dorsal aspect of left elytron of coccinellid pupae.
Fig. 153. *Anatis ocellata*
Fig. 154. *Anatis quindecimpunctata*
Fig. 155. *Coleomegilla maculata*
Fig. 156. *Coleomegilla maculata*
Fig. 157. *Eriopis connexa*
Fig. 158. *Hippodamia quinquesignata,* viewed from the apex.
Fig. 159. *Hippodamia parenthesis,* viewed from the apex.
Fig. 160. *Hippodamia tredecimpunctata,* light form.
Fig. 161. *Hippodamia tredecimpunctata,* cross section of the elytron across the lateral margin.
Fig. 162. *Scymnus creperus,* cross section of the elytron across the lateral margin.
Fig. 163. *Hippodamia parenthesis*

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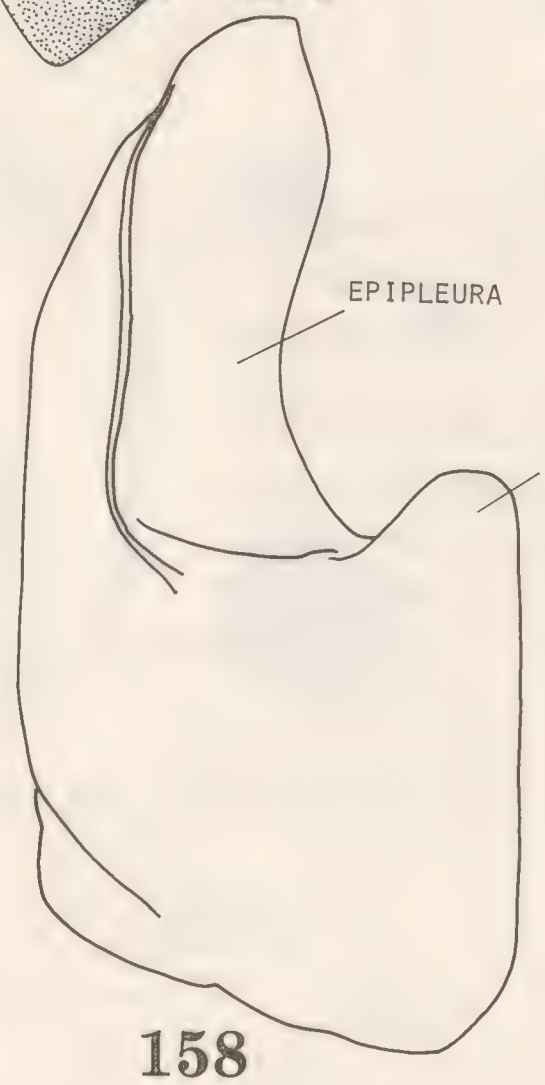

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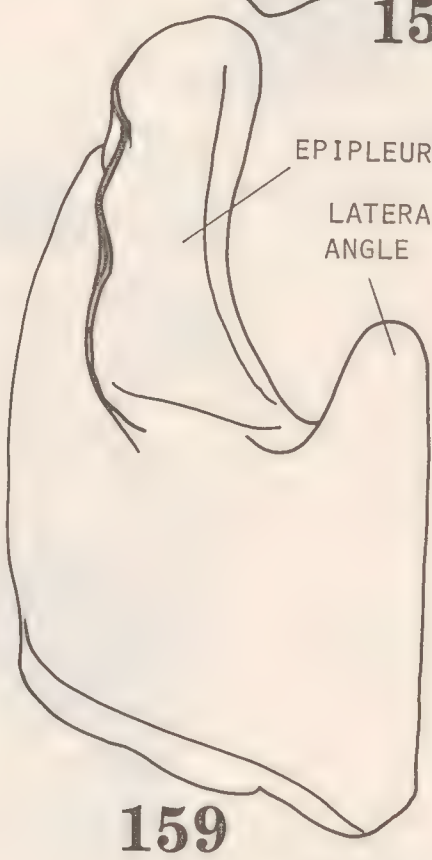

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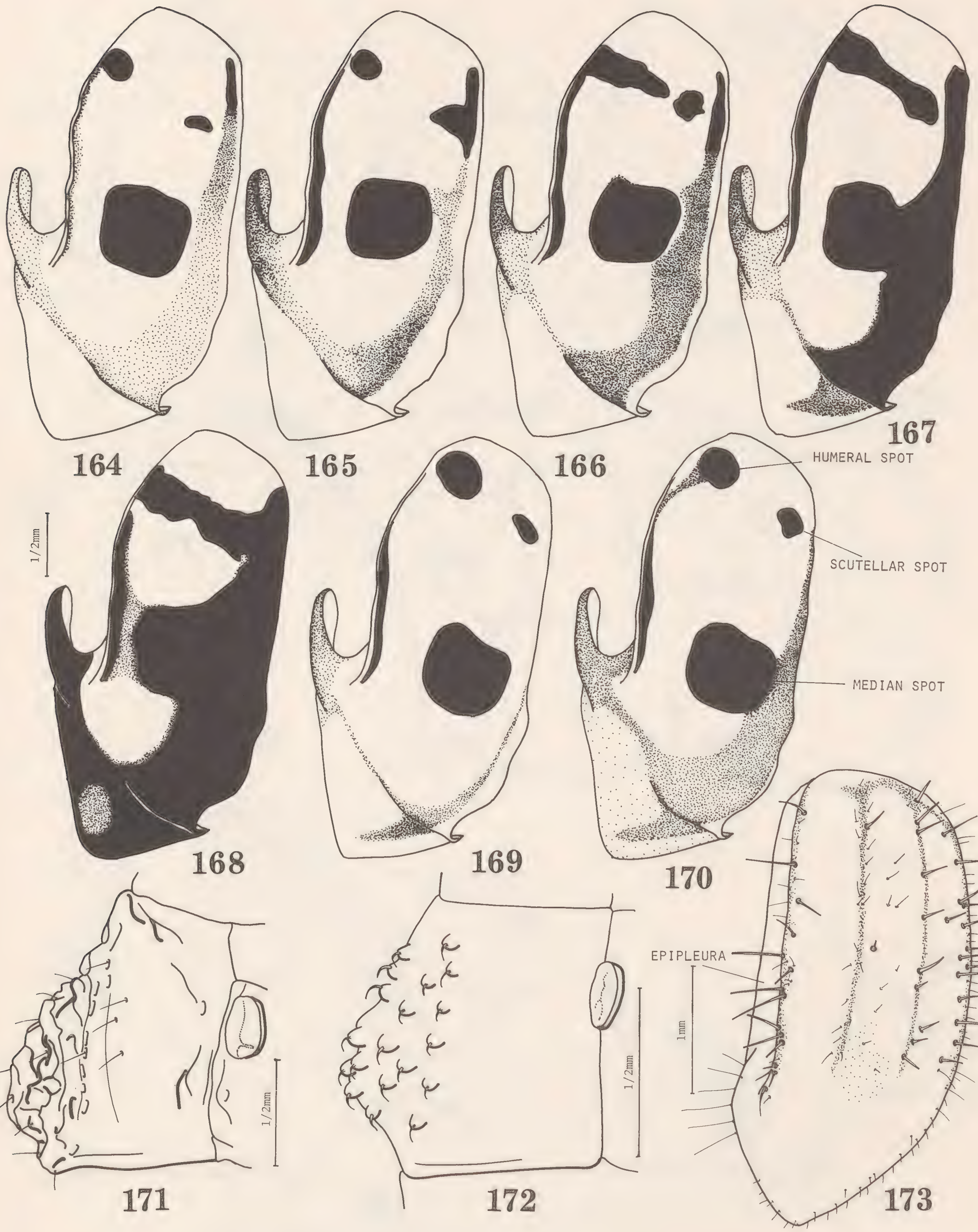
Figs. 164-170: Dorsal aspect of the elytron of coccinellid pupae.
Fig. 164. *Hippodamia quinquesignata*
Fig. 165. *Hippodamia quinquesignata*
Fig. 166. *Hippodamia quinquesignata*
Fig. 167. *Hippodamia quinquesignata*
Fig. 168. *Hippodamia quinquesignata*
Fig. 169. *Hippodamia glacialis*
Fig. 170. *Hippodamia glacialis*
Figs. 171-172: Third left abdominal pleuron of coccinellid pupae.
Fig. 171. *Neoharmonia venusta*
Fig. 172. *Propylaea quatuordecimpunctata*
Fig. 173. *Epilachna varivestis,* dorsal aspect of left elytron.


1/2mm
HUMERAL SPOT
SCUTELLAR SPOT
MEDIAN SPOT
EPIPLEURA
1mm
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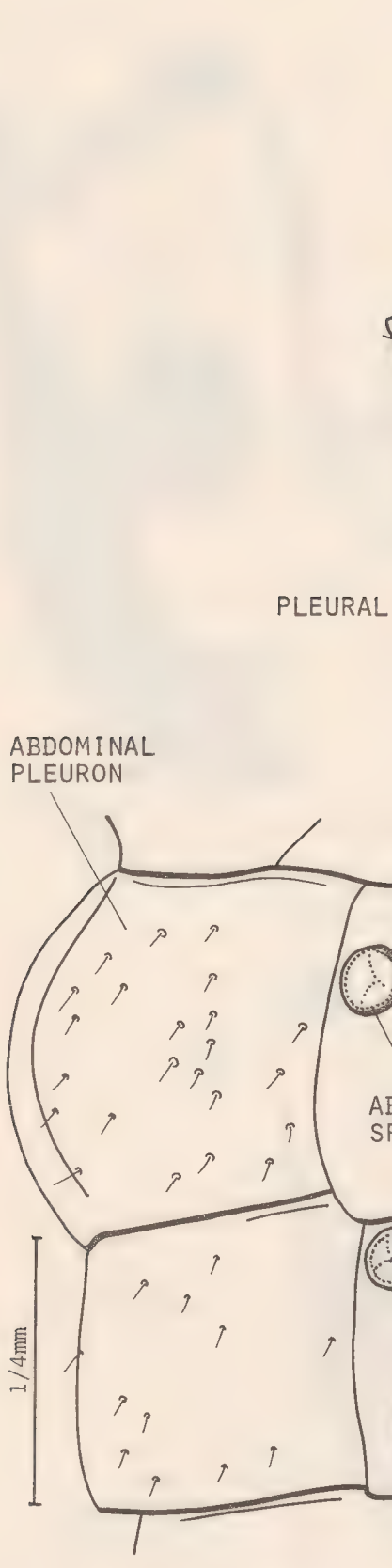

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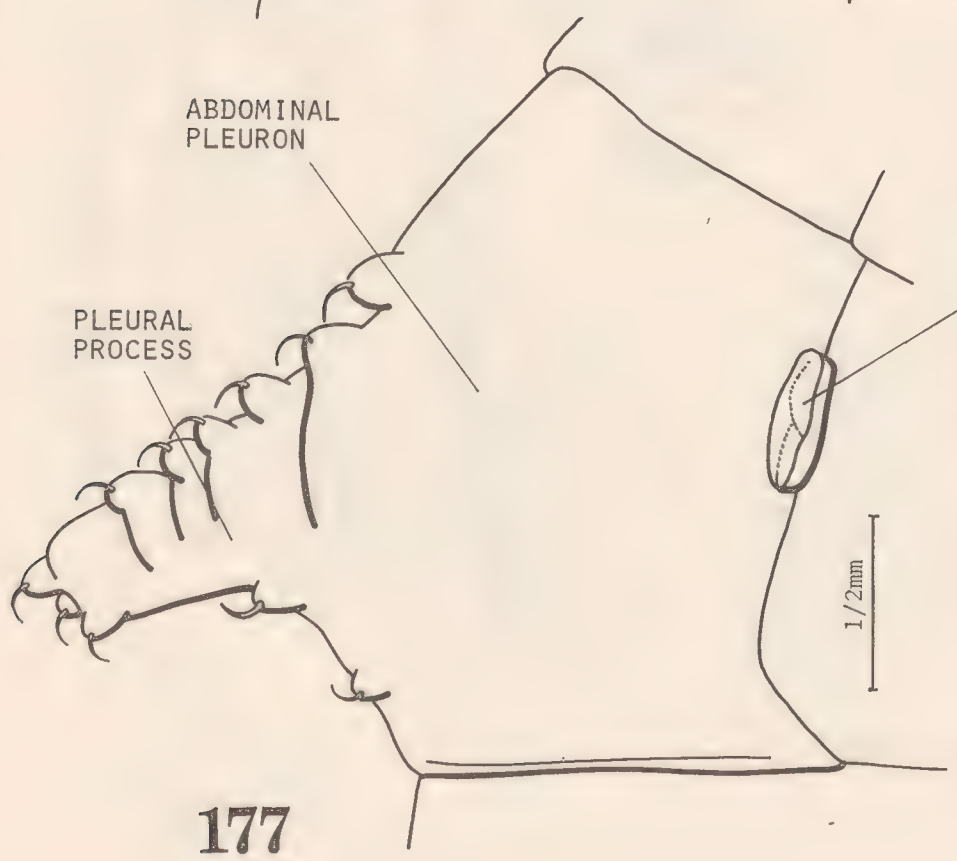

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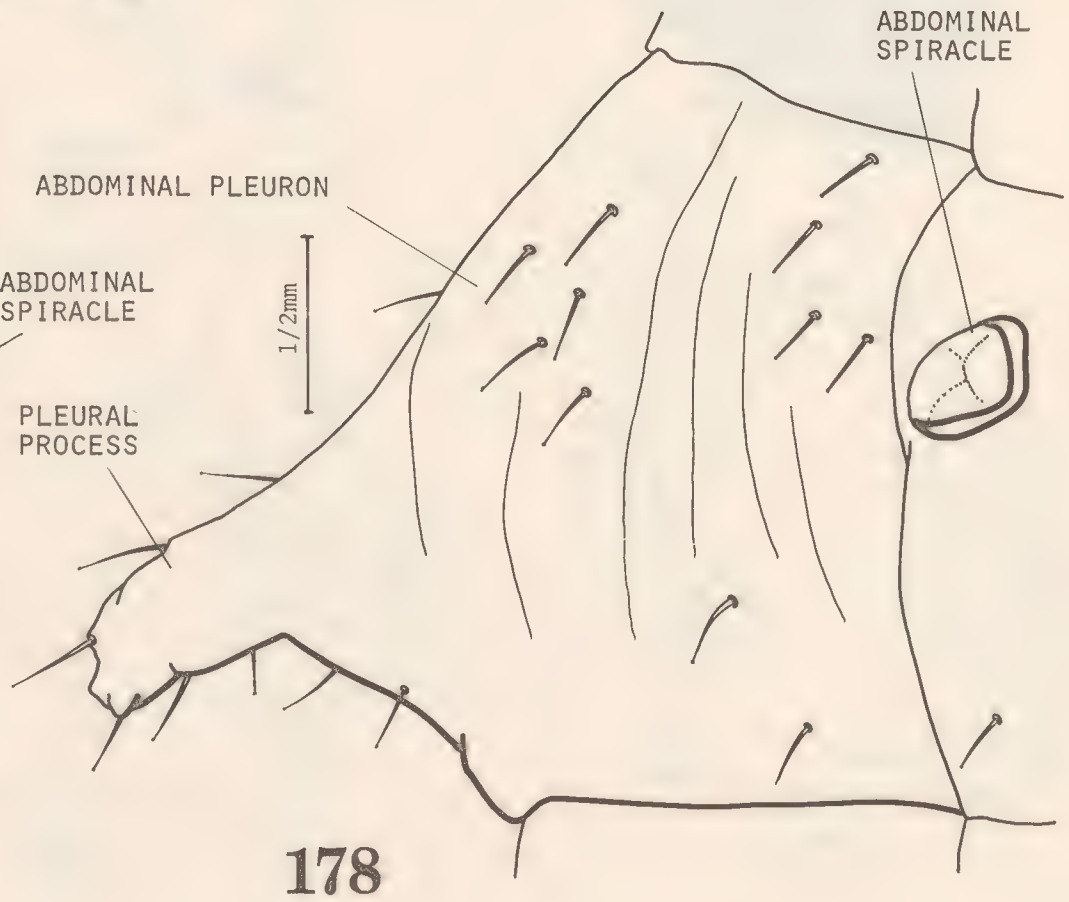

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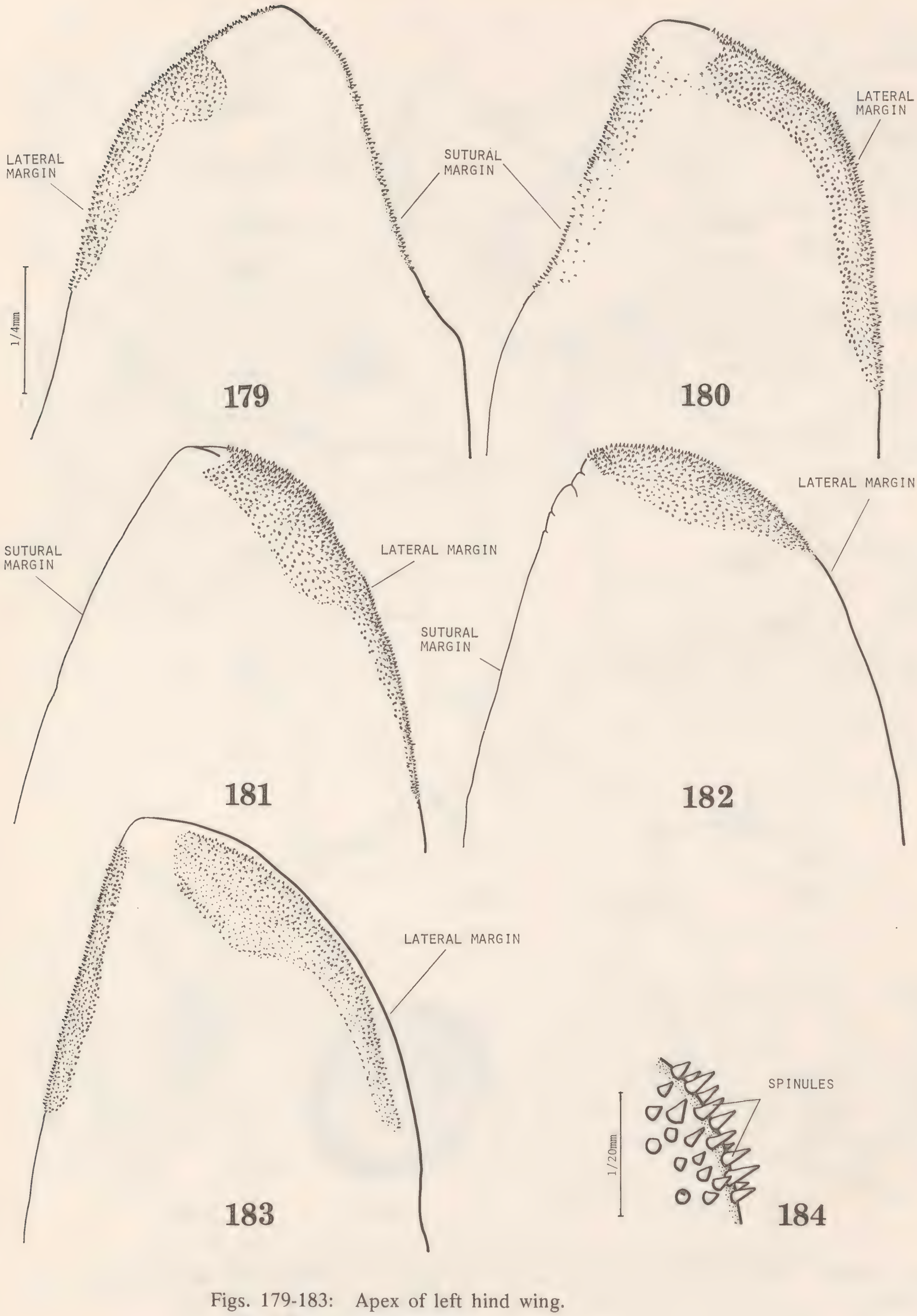
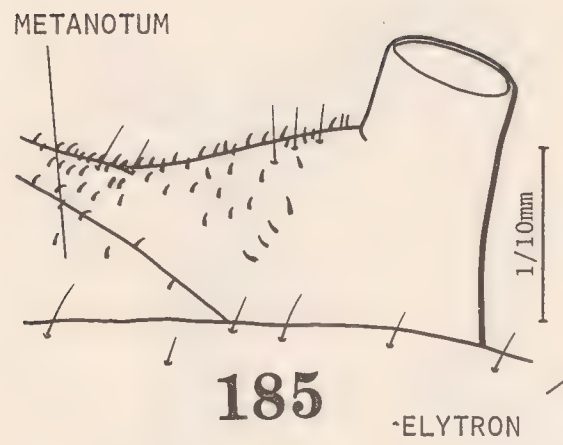
Figs. 174-178: Third left abdominal pleuron of coccinellid pupae.
Fig. 174. *Coleomegilla maculata,* third and fourth pleura.
Fig. 175. *Eriopis connexa,* third and fourth pleura.
Fig. 176. *Synonycha grandis*
Fig. 177. *Anisocalvia quatuordecimguttata*
Fig. 178. *Anatis ocellata*



Figs. 179-183: Apex of left hind wing.
Fig. 179. *Adalia bipunctata,* dorsal aspect.
Fig. 180. *Adalia bipunctata,* ventral aspect.
Fig. 181. *Coccinella transversoguttata,* ventral aspect.
Fig. 182. *Coccinella monticola,* ventral aspect.
Fig. 183. *Coccinella trifasciata,* ventral aspect.
Fig. 184. A close-up portion of spinulate area on hind wing apex.



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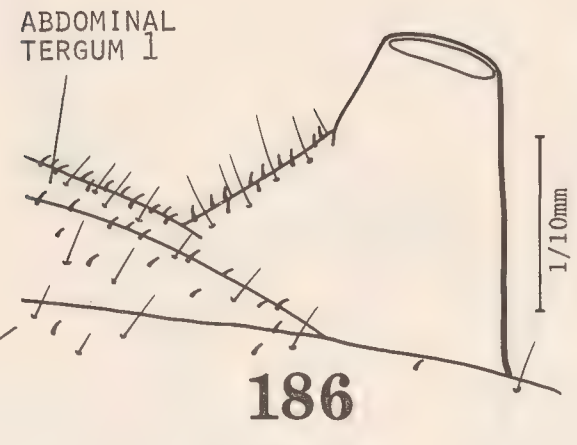

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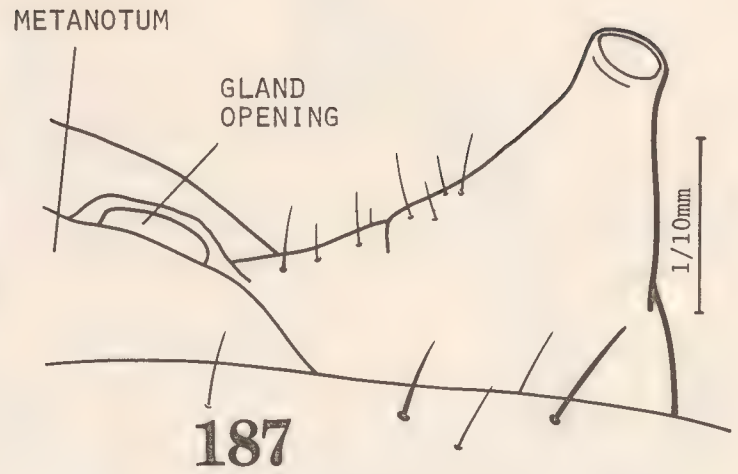

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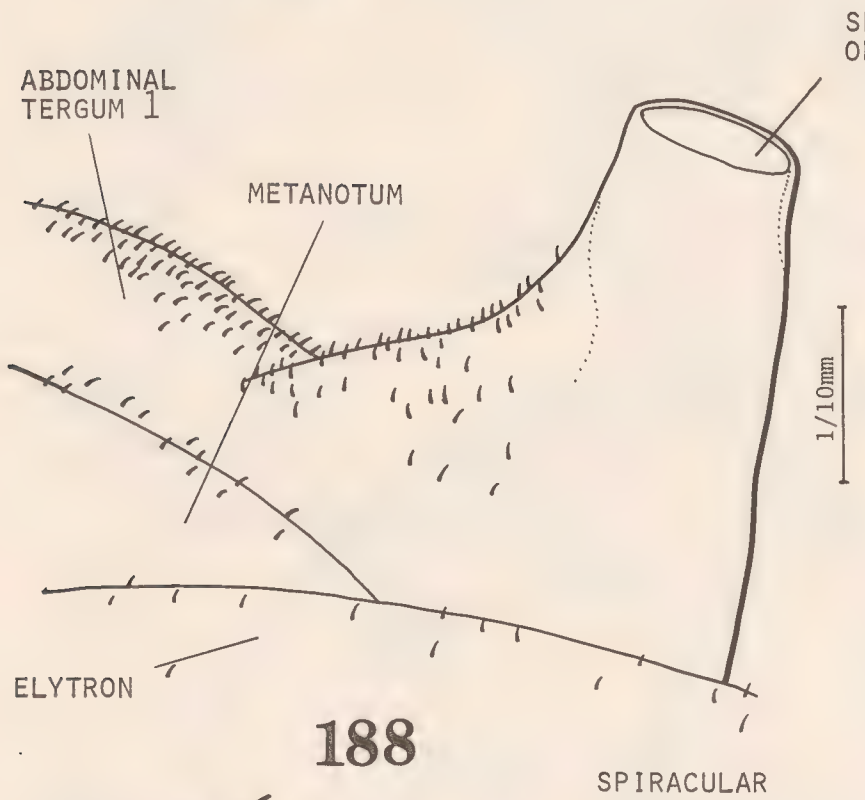

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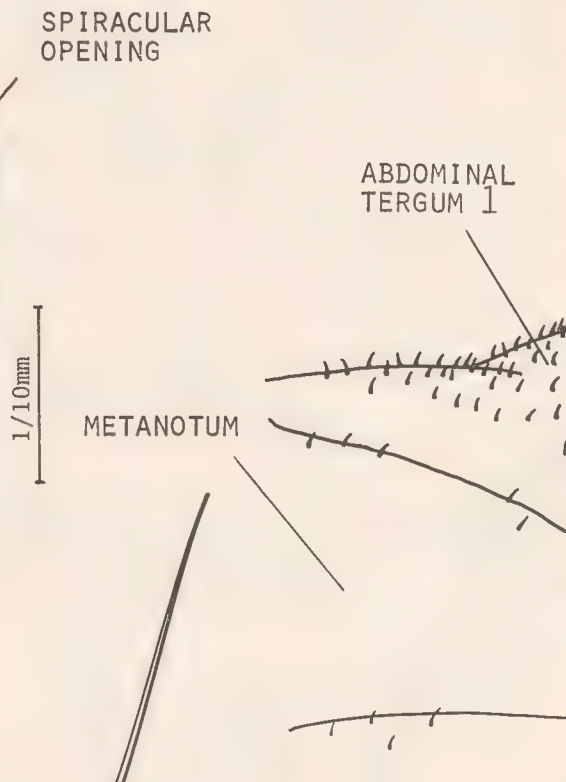

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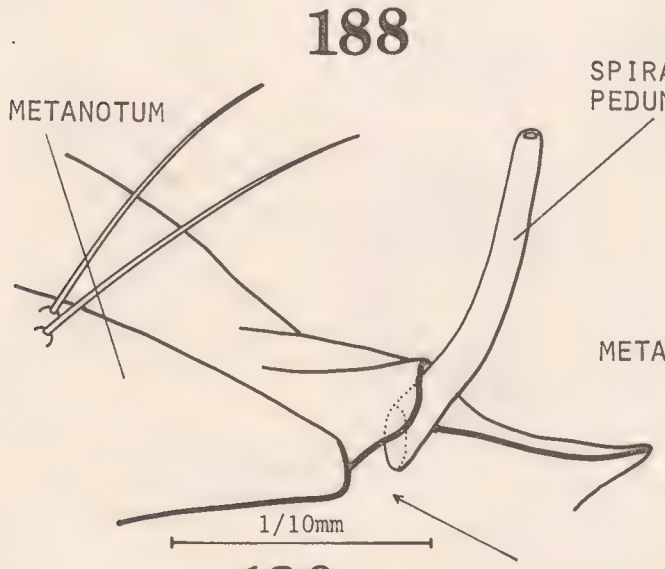

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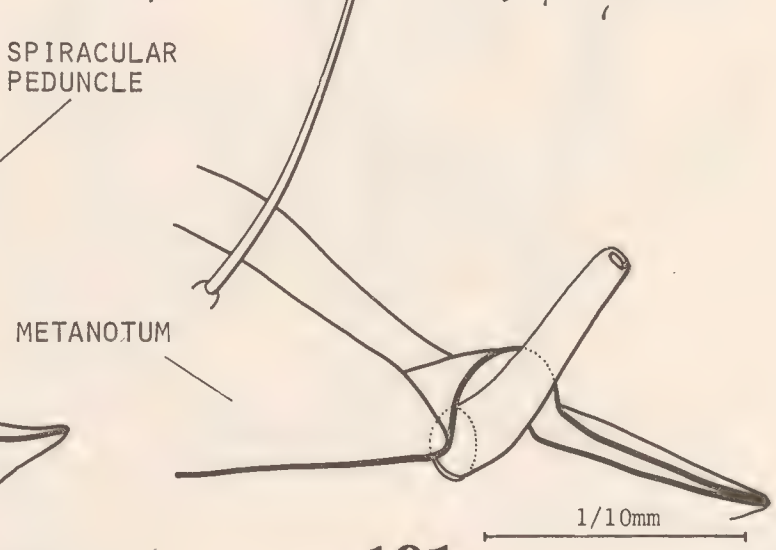

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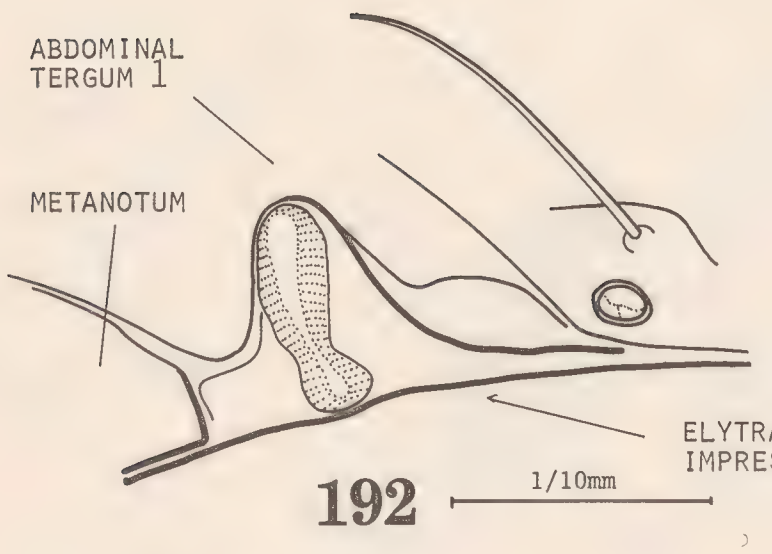

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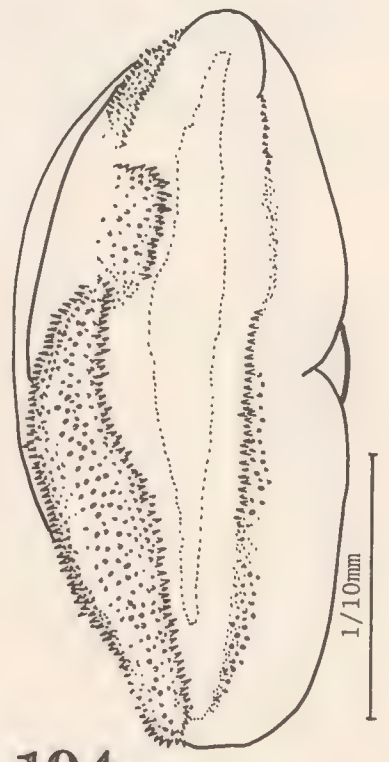


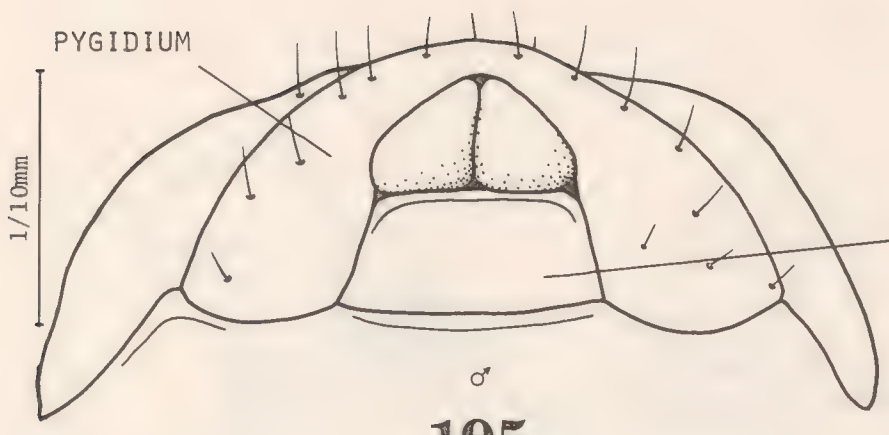
194

Figs. 185-192: Pedunculate spiracle, first abdominal segment, frontal aspect, as viewed from the pronotum.

Fig. 185. *Exochomus hoegei*
Fig. 186. *Exochomus cubensis*
Fig. 187. *Brumoides suturalis*
Fig. 188. *Axion plagiatum*
Fig. 189. *Axion tripustulatum*
Fig. 190. *Stethorus punctum*
Fig. 191. *Stethorus punctum*
Fig. 192. *Stethorus atomus,* lateral aspect after removing the elytron.

Figs. 193-194: Prothoracic spiracle

Fig. 193. *Adalia bipunctata*
Fig. 194. *Coccinella transversoguttata*



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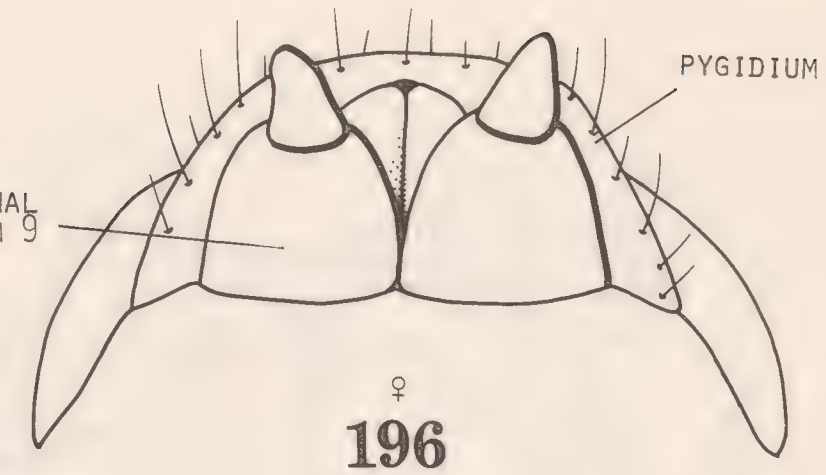

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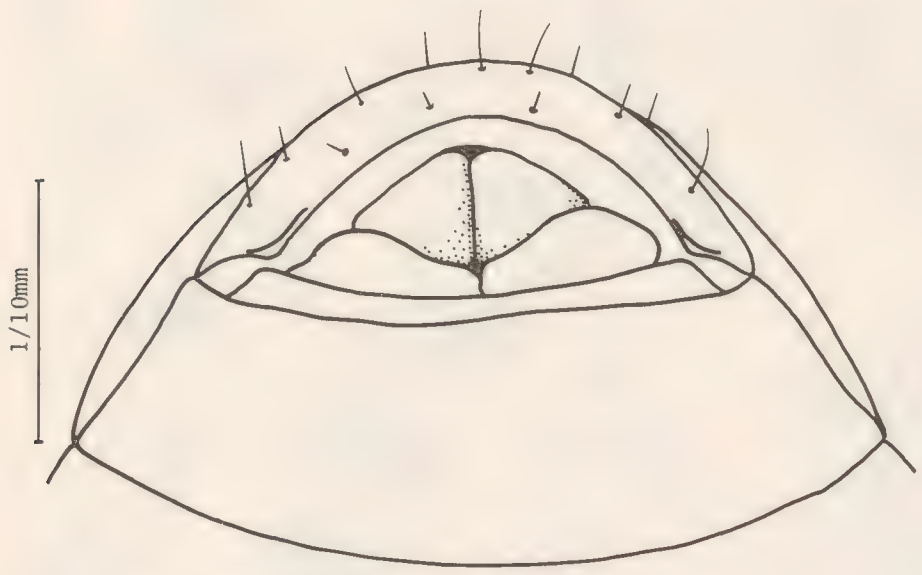

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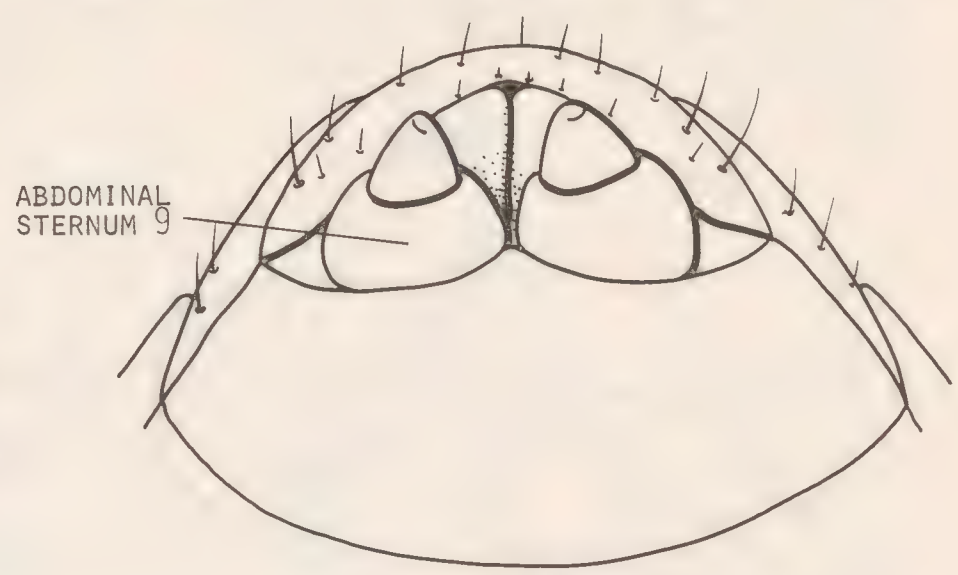

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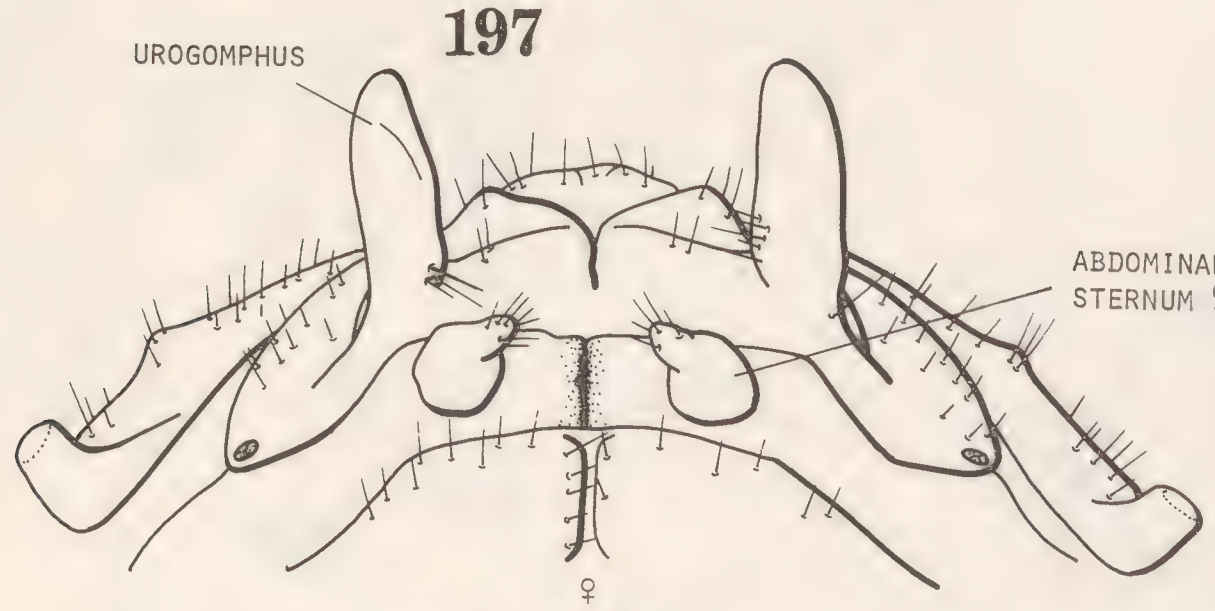

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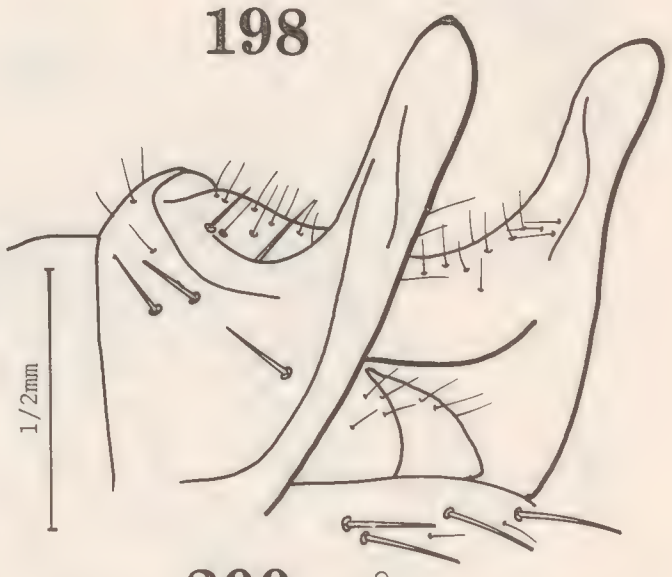

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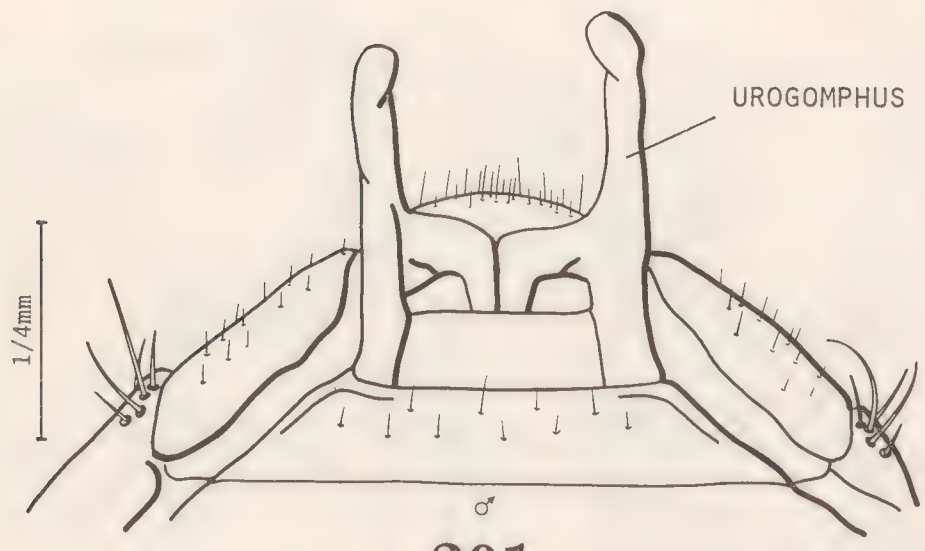

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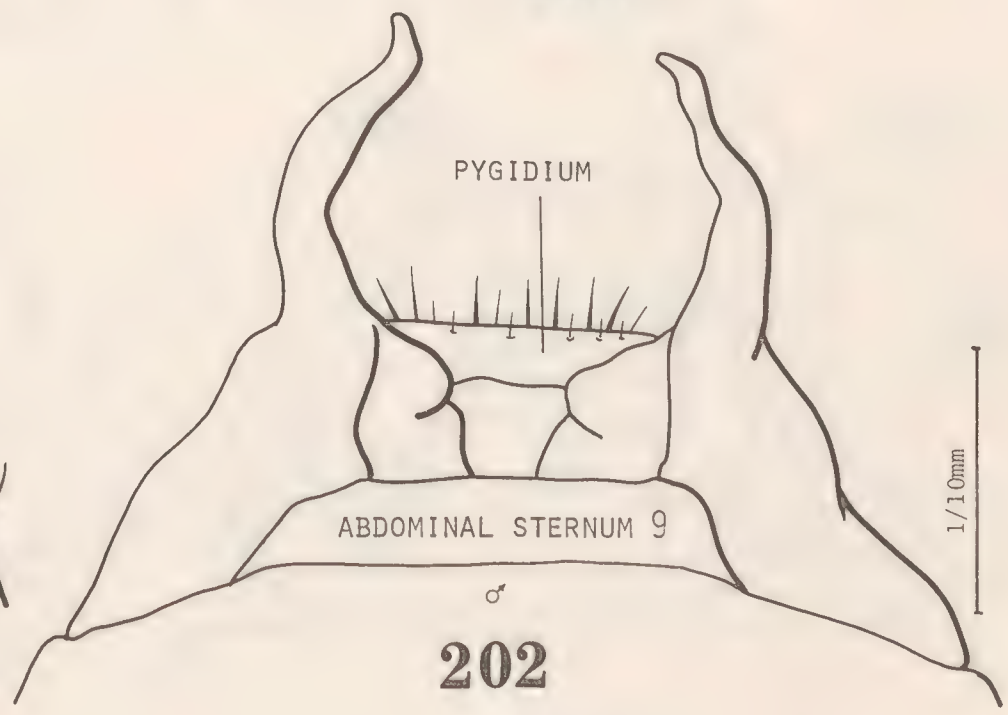

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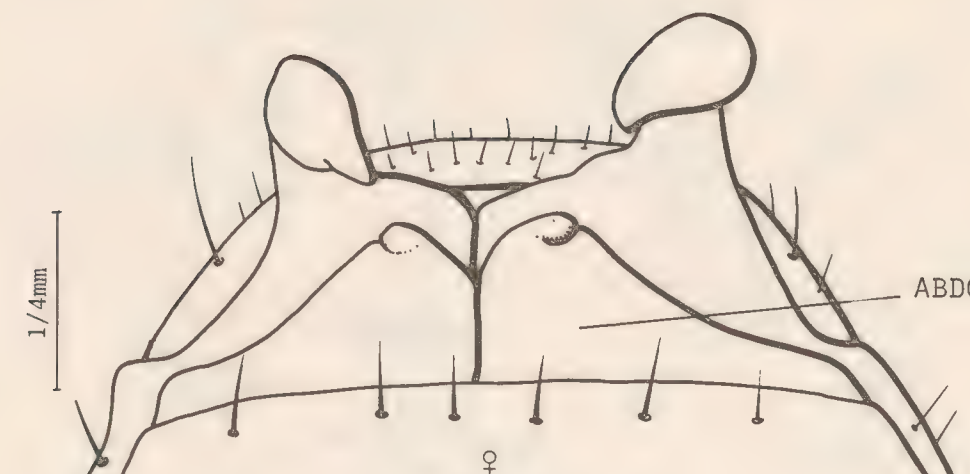
Figs. 195-202: Ventral aspect of the tip of the abdomen of coccinellid pupae.

Fig. 195. *Delphastus pusillus* ♂
Fig. 196. *Delphastus pusillus* ♀
Fig. 197. *Microweisea ovalis* ♂
Fig. 198. *Microweisea ovalis* ♀
Fig. 199. *Epilachna varivestis* ♀
Fig. 200. *Epilachna varivestis* ♀ (Lateral aspect)
Fig. 201. *Scymnus creperus* ♂
Fig. 202. *Lindorus lophantae* ♂



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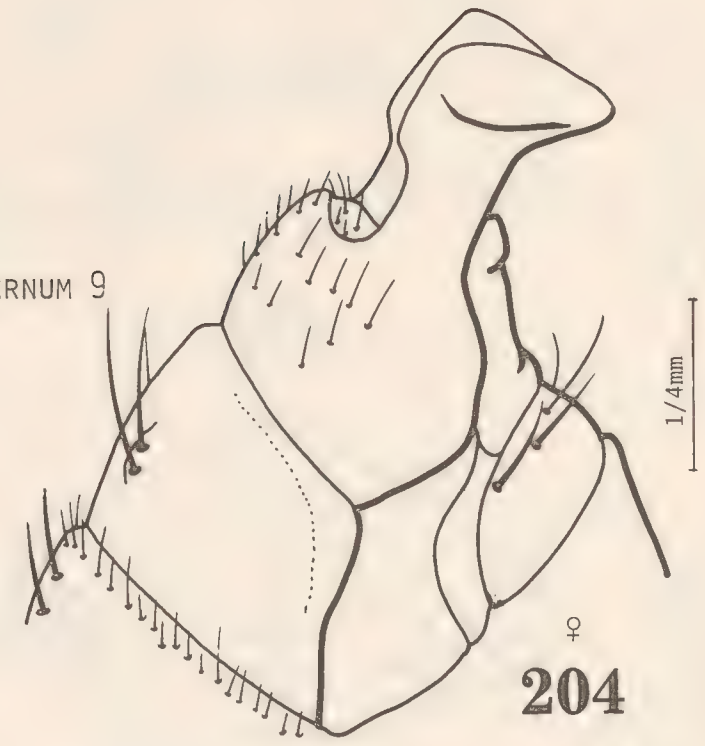

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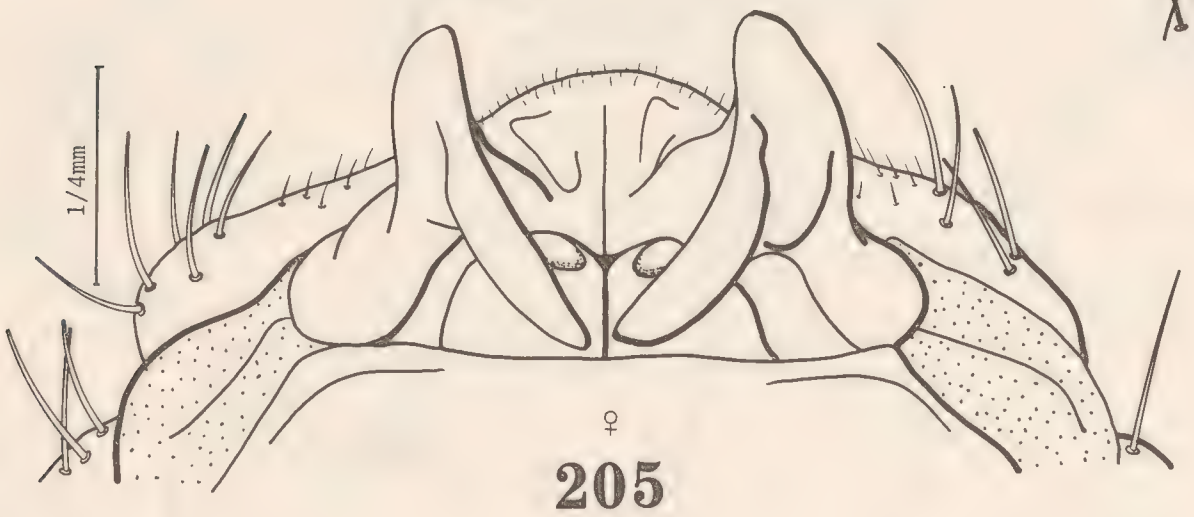

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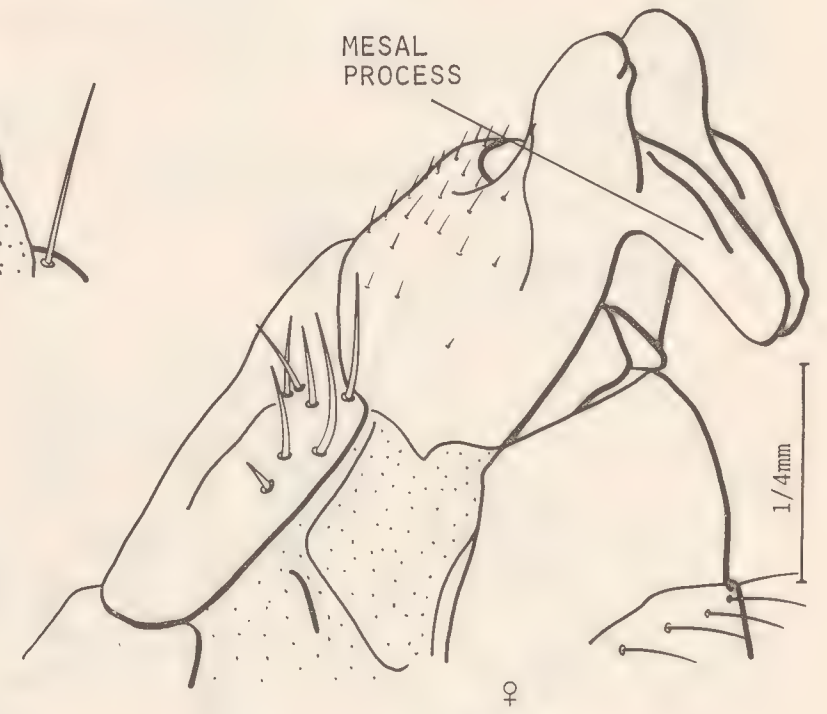

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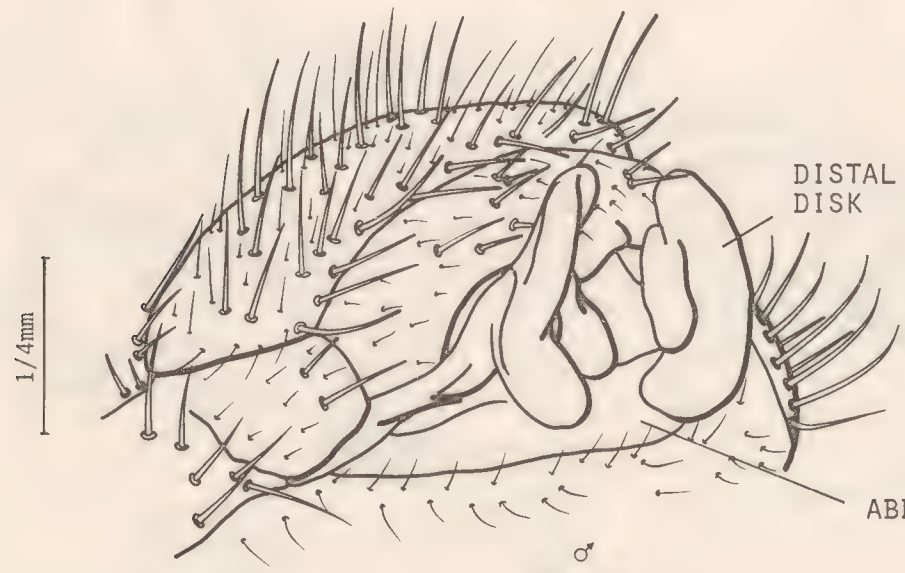

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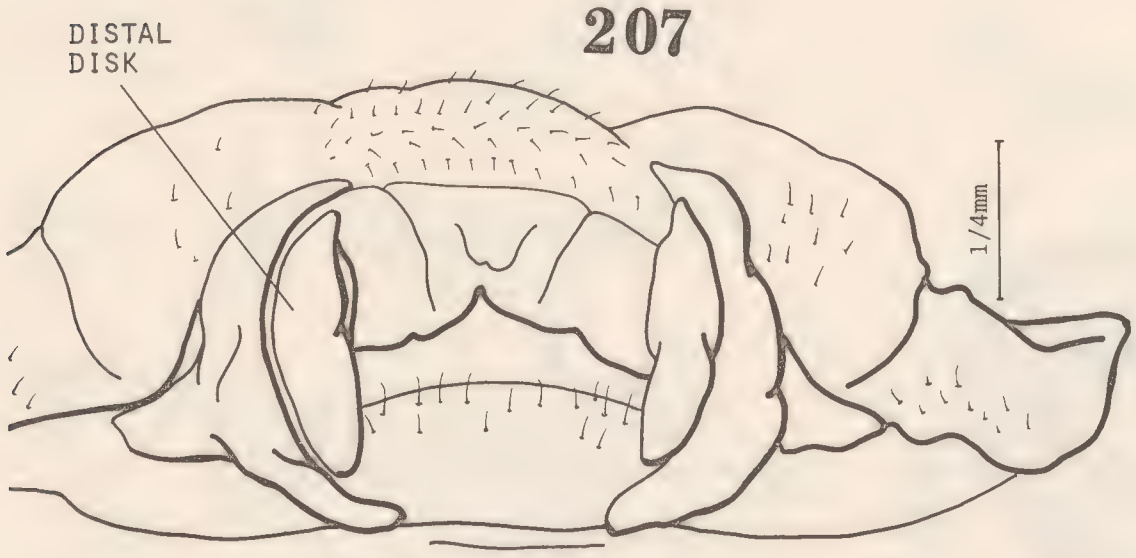

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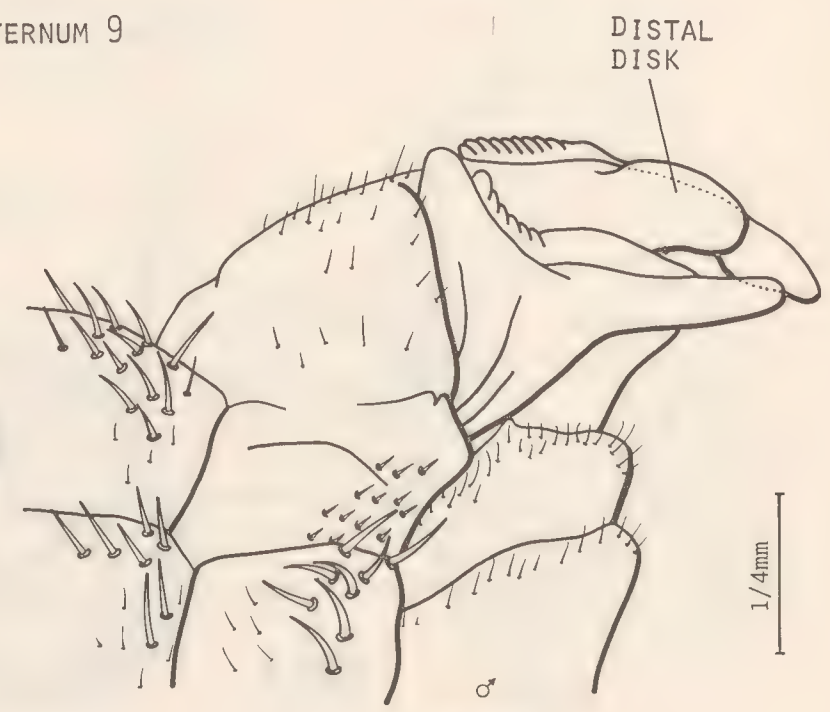

209

Figs. 203-209: Ventral aspect of the tip of the abdomen of coccinellid pupae.

Fig. 203. *Zagloba ornata* ♀

Fig. 204. *Zagloba ornata* ♀ , *lateral aspect.*

Fig. 205. *Cryptolaemus montrouzieri* ♀

Fig. 206. *Cryptolaemus montrouzieri* ♀ (lateral aspect).

Fig. 207. *Hyperaspis binotata* ♂

Fig. 208. *Thalassa montezumae* ♂

Fig. 209. *Thalassa montezumae* ♂ (lateral aspect).

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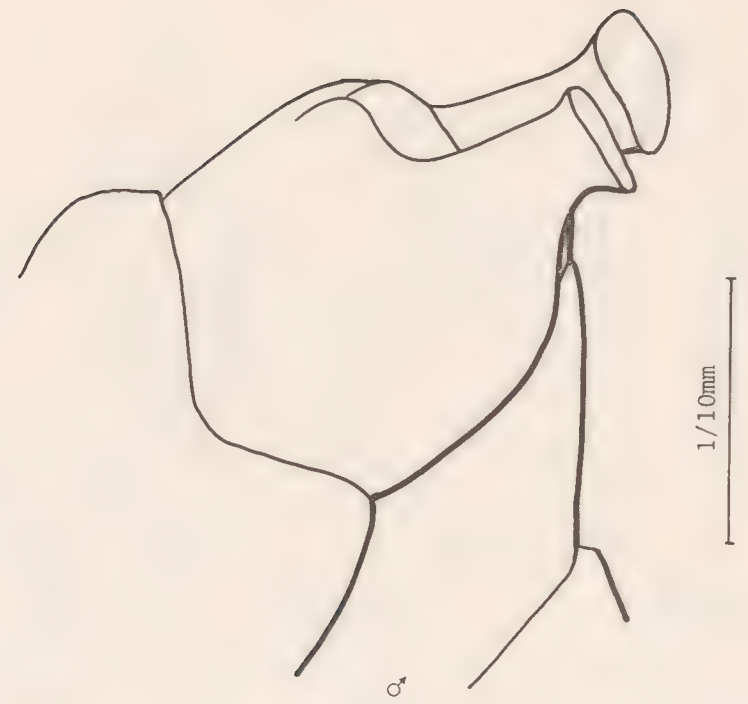

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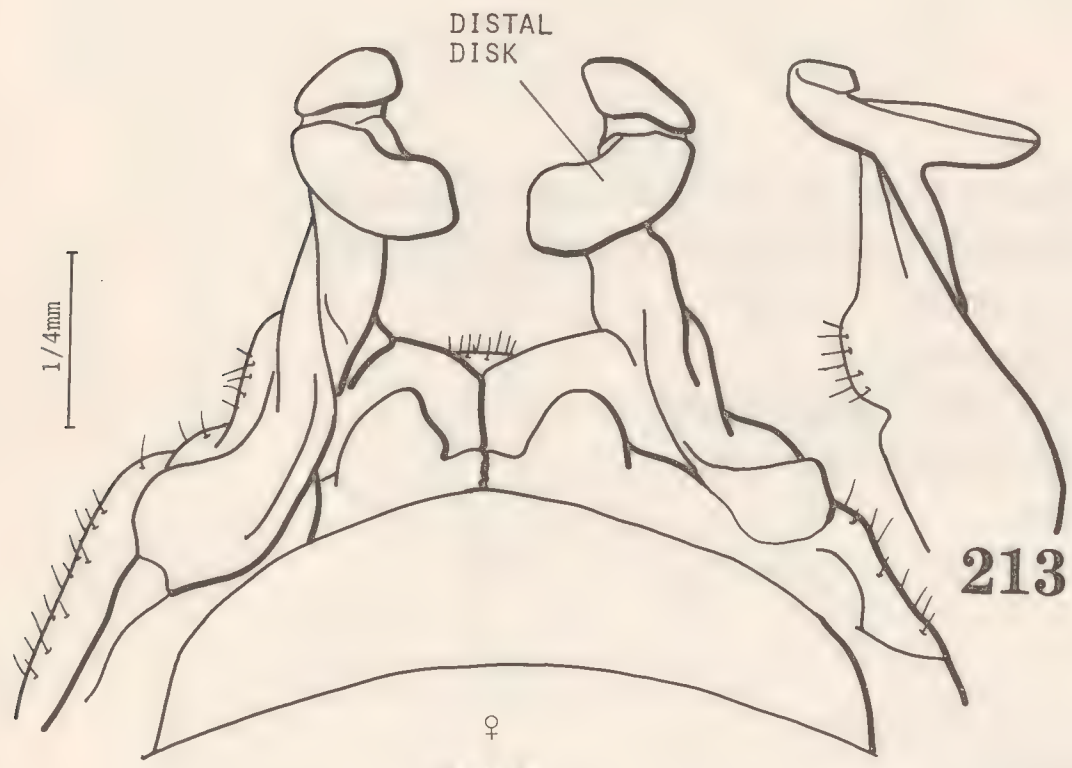

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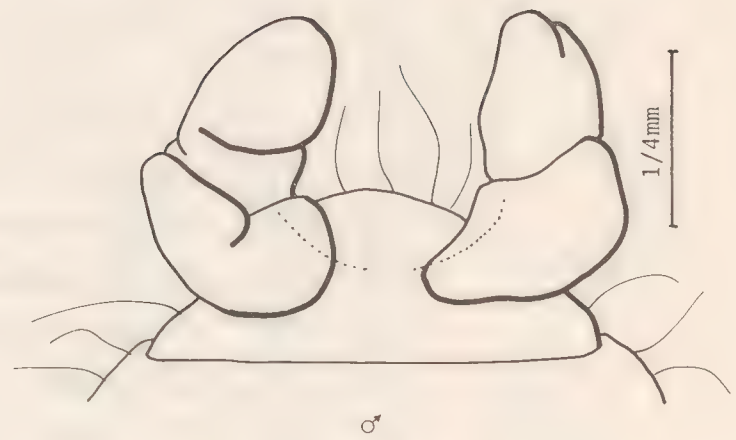

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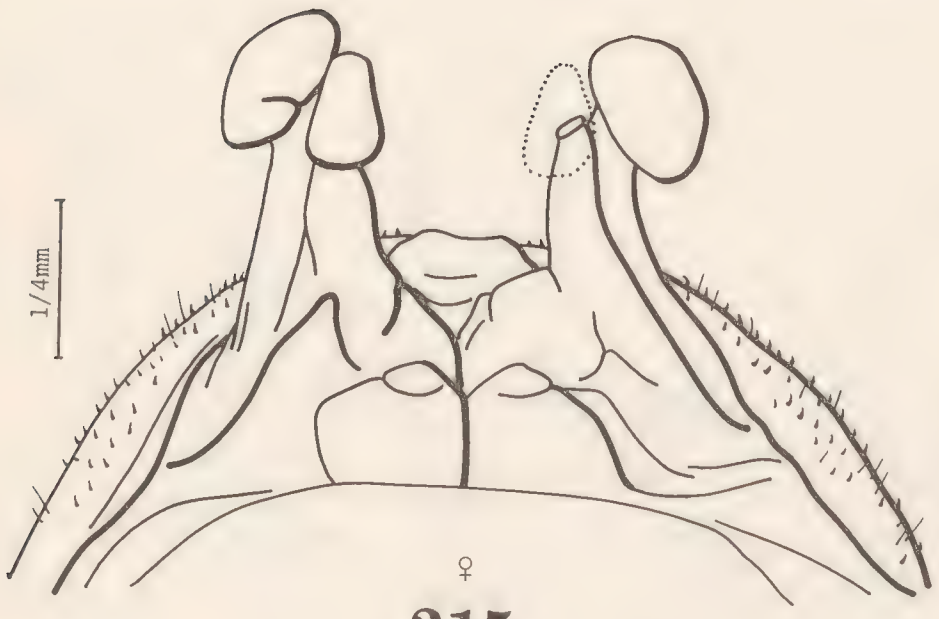

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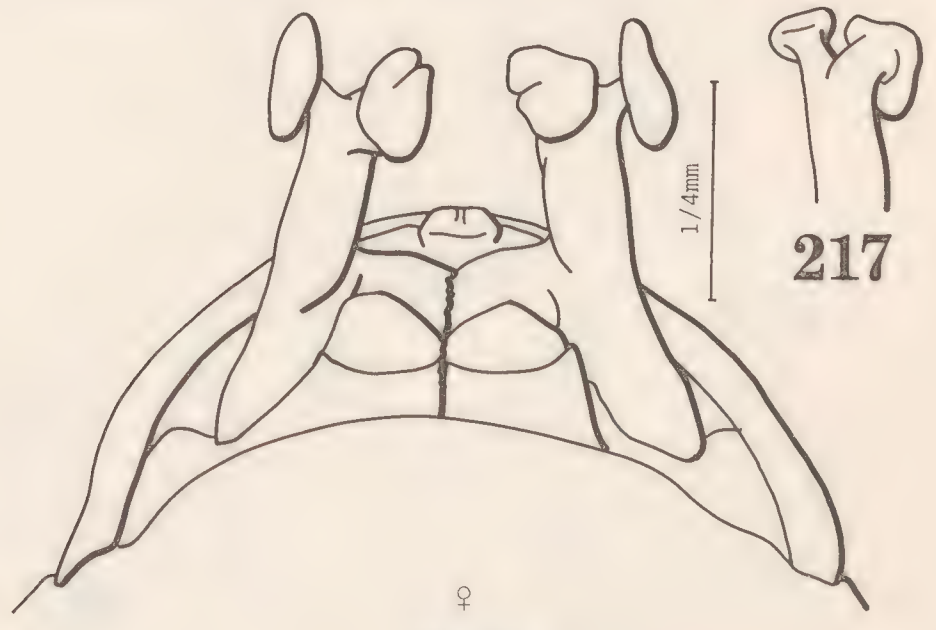

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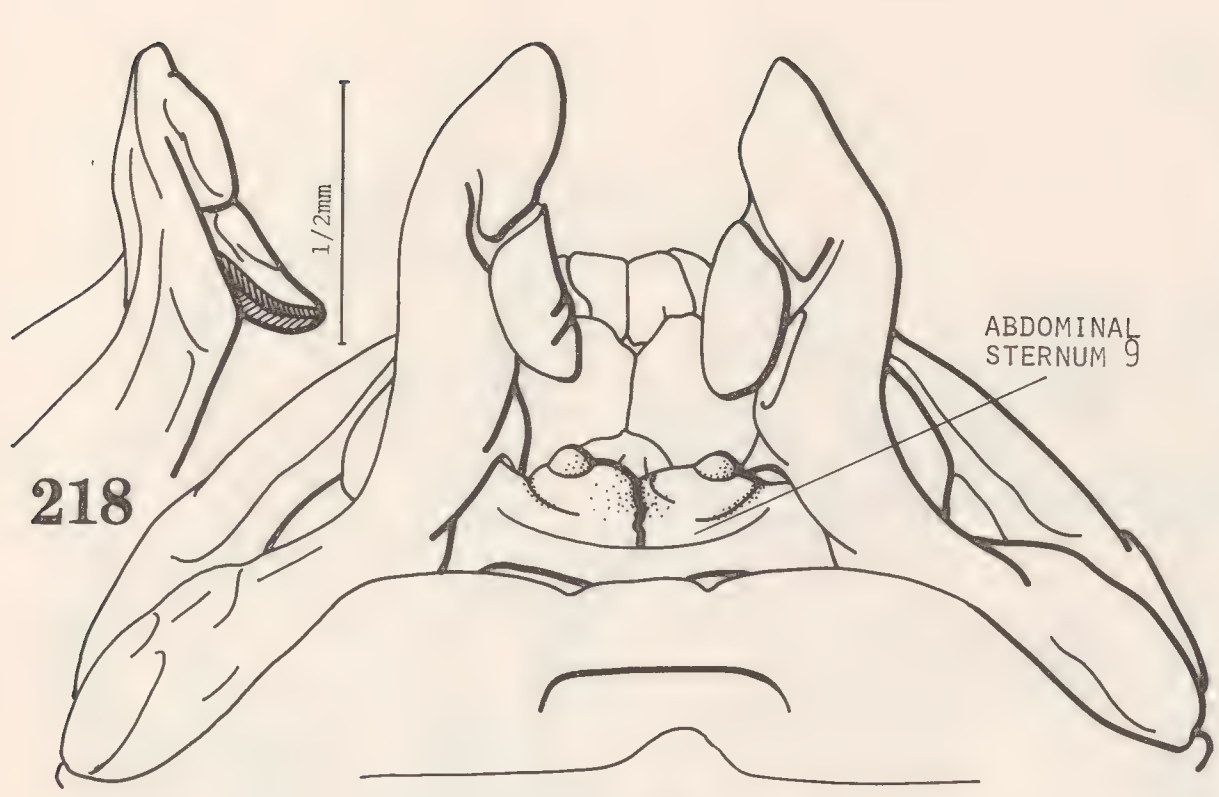
Figs. 210-217: Ventral aspect of the tip of the abdomen of coccinellid pupae.
Fig. 210. *Stethorus atomus* ♂
Fig. 211. *Stethorus atomus* ♂ lateral aspect.
Fig. 212. *Chilocorus bivulnerus* ♀
Fig. 213. *Chilocorus bivulnerus,* lateral aspect of a right urogomphus.
Fig. 214. *Orcus chalybeus*
Fig. 215. *Axion plagiatum* ♀
Fig. 216. *Brumoides suturalis* ♀
Fig. 217. *Brumoides suturalis,* dorsal aspect of a right urogomphus.

Figs. 218-220: Ventral aspect of the tip of the abdomen of coccinellid pupae.
Fig. 218. *Coccinella transversoguttata,* lateral aspect of a left urogomphus.
Fig. 219. *Coccinella transversoguttata* ♀
Fig. 220. *Coccinella transversoguttata* ♂
Figs. 221-231: Ventral aspect of a right urogomphus.
Fig. 221. *Anisocalvia quatuordecimguttata*
Fig. 222. *Neoharmonia venusta*
Fig. 223. *Anatis quindecimpunctata*
Fig. 224. *Anatis ocellata*
Fig. 225. *Olla abdominalis*
Fig. 226. *Olla abdominalis,* lateral aspect.
Fig. 227. *Hippodamia parenthesis*
Fig. 228. *Hippodamia parenthesis,* lateral aspect.
Fig. 229. *Psyllobora vigintimaculata*
Fig. 230. *Rodolia cardinalis*
Fig. 231. *Rodolia cardinalis,* lateral aspect.



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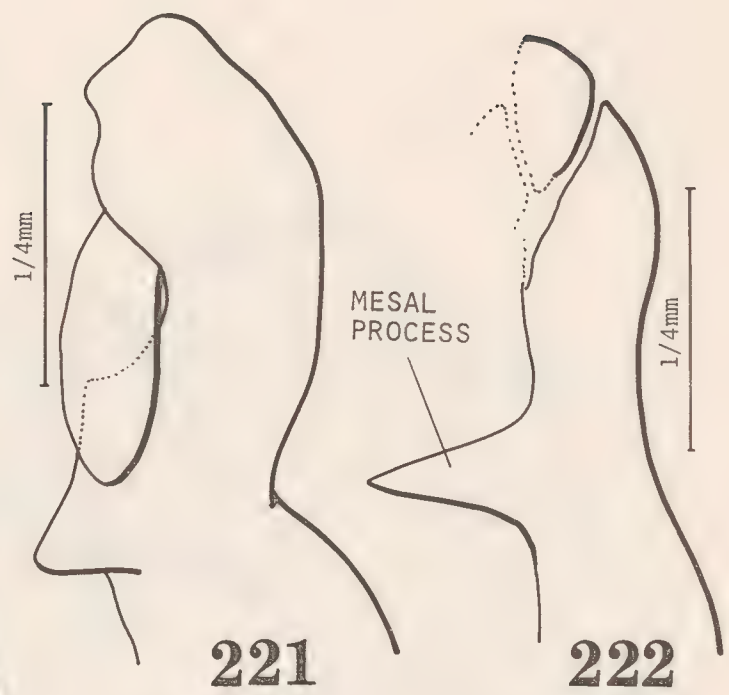

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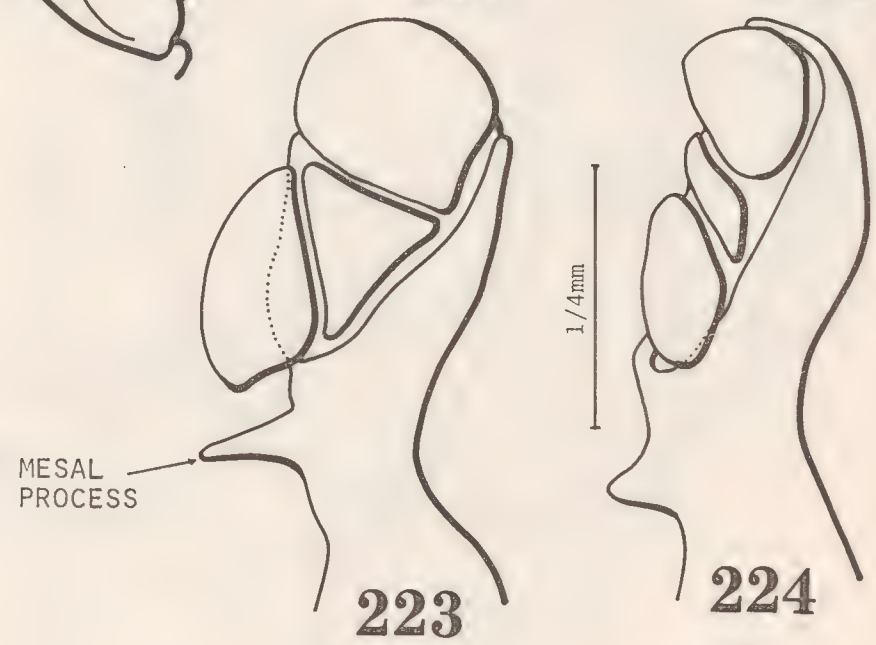

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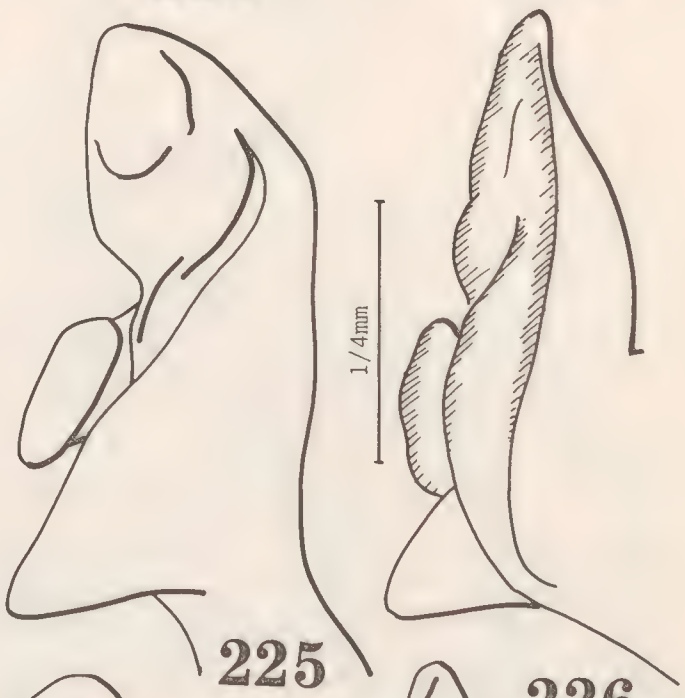

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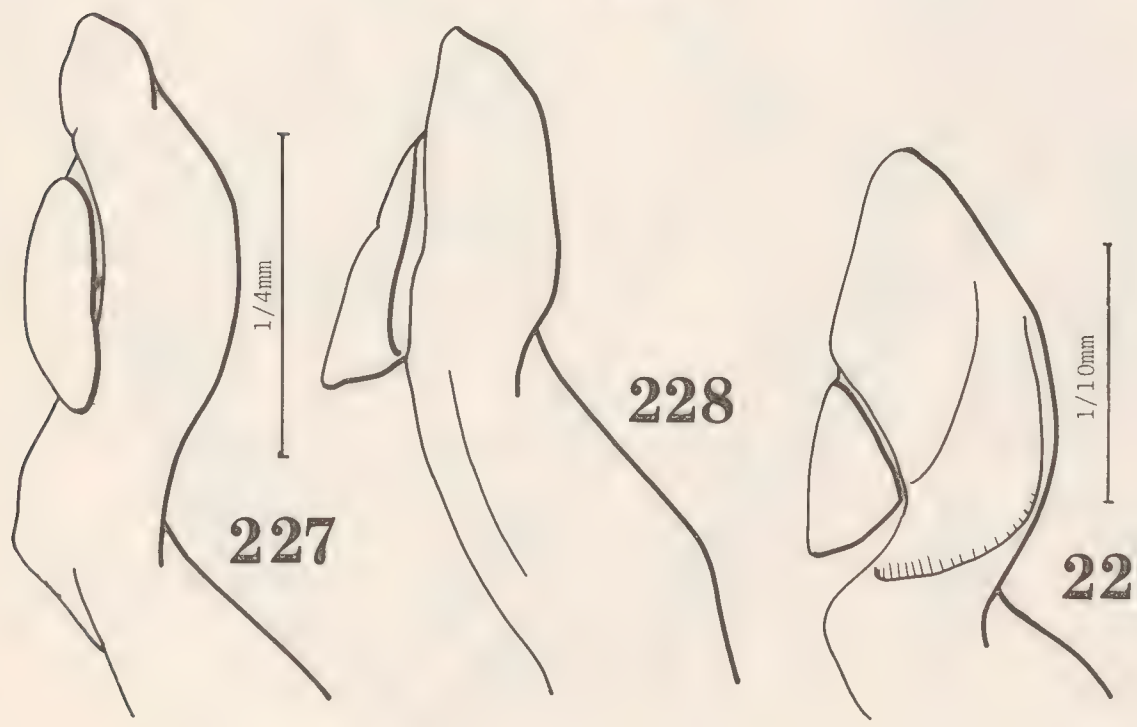

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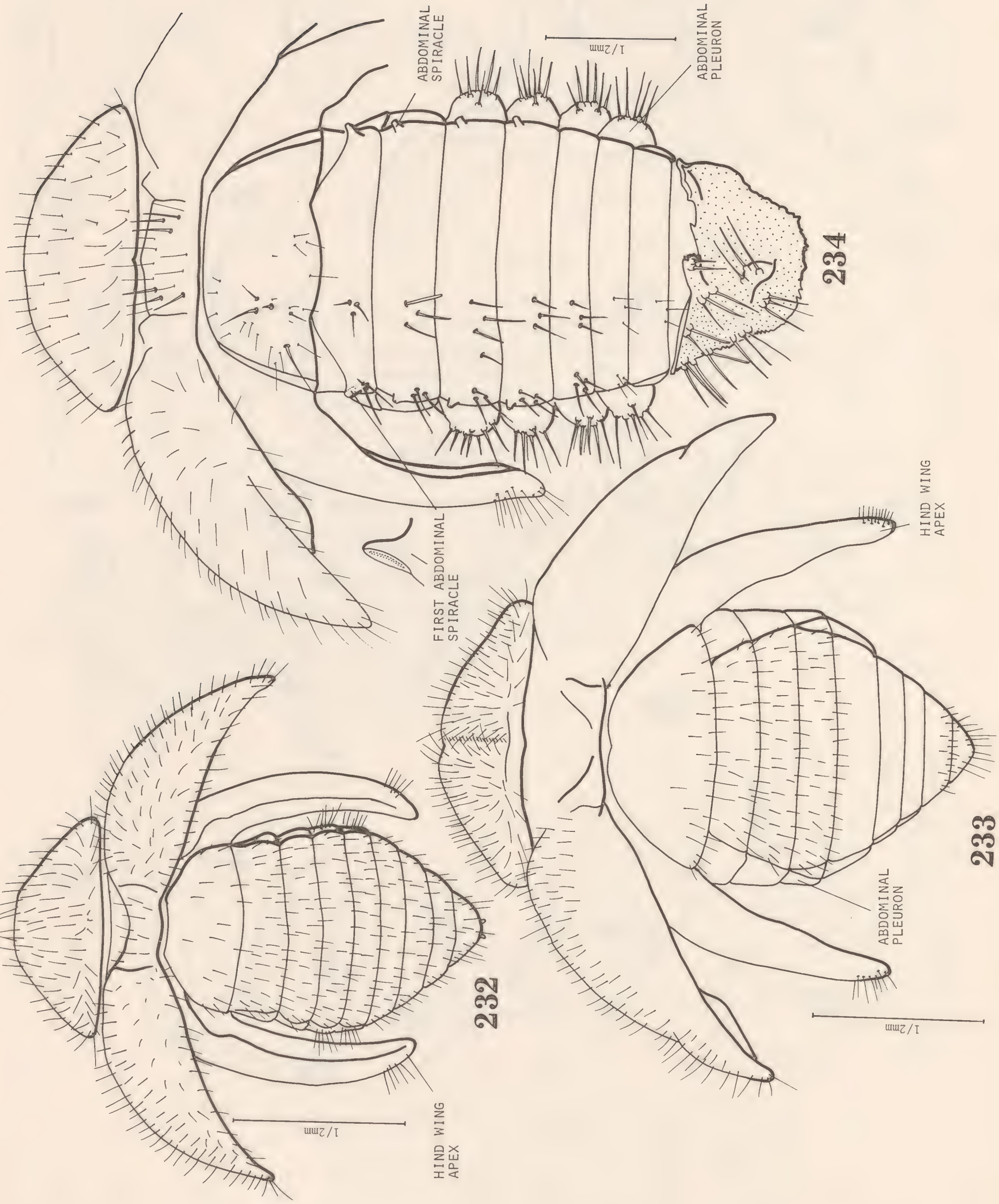
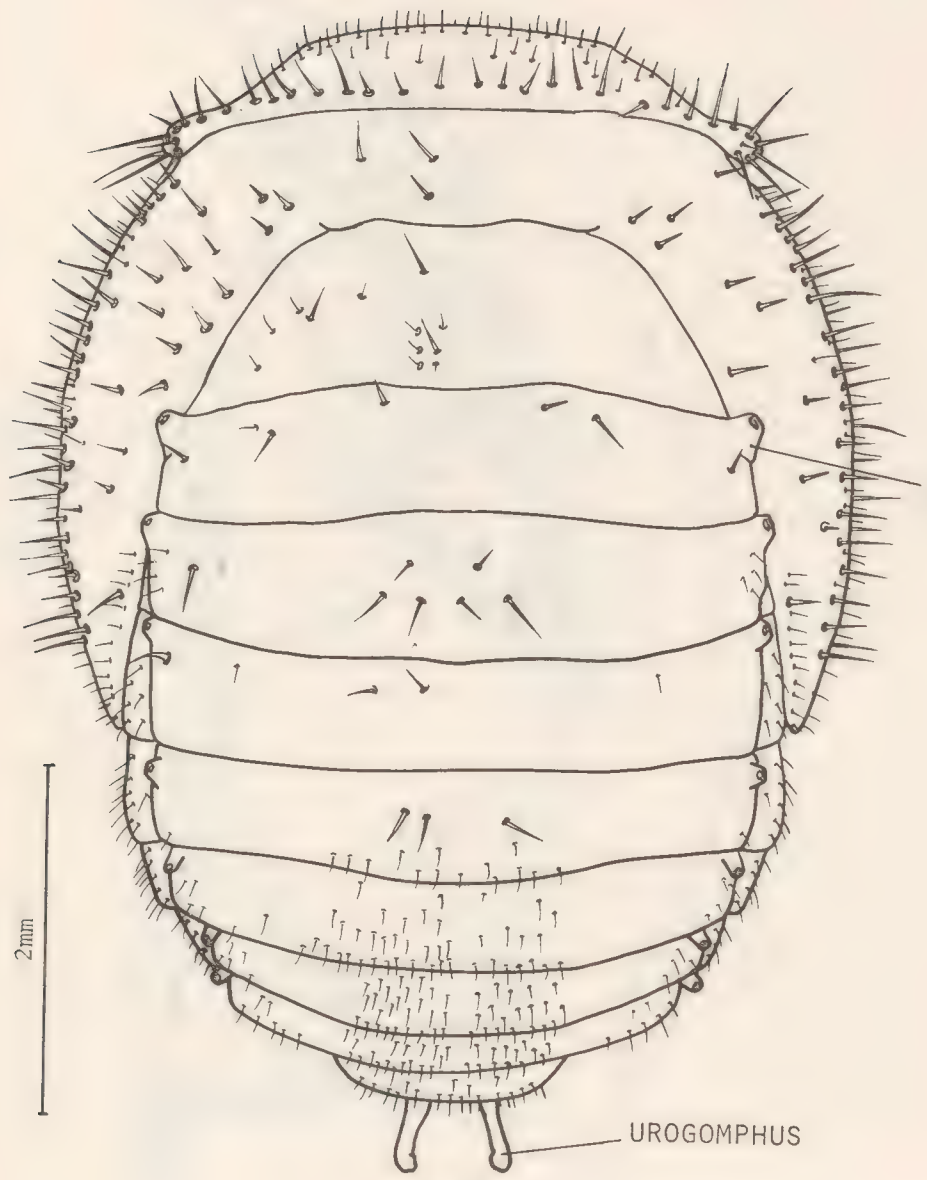


Fig. 232. *Microweisea ovalis,* dorsal aspect.
Fig. 233. *Delphastus pusillus,* dorsal aspect.
Fig. 234. *Lindorus lophantae,* dorsal aspect.



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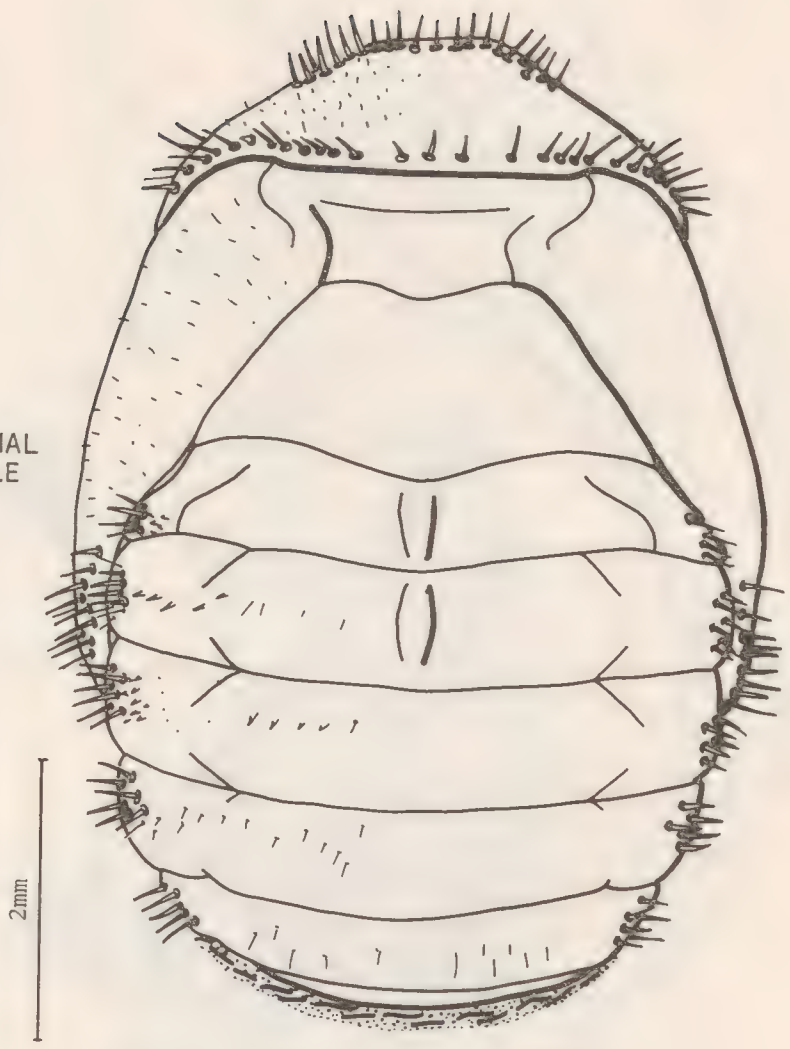

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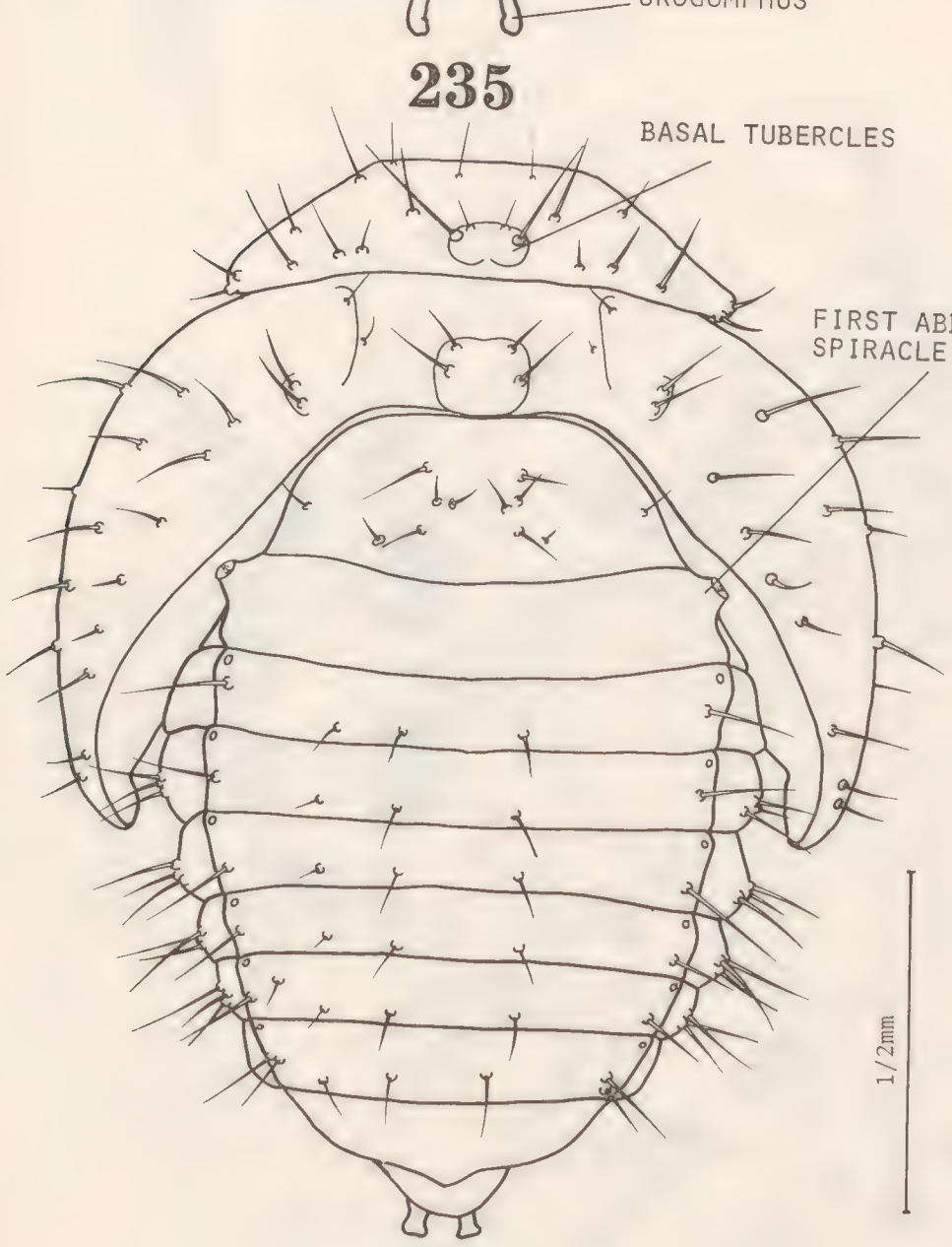

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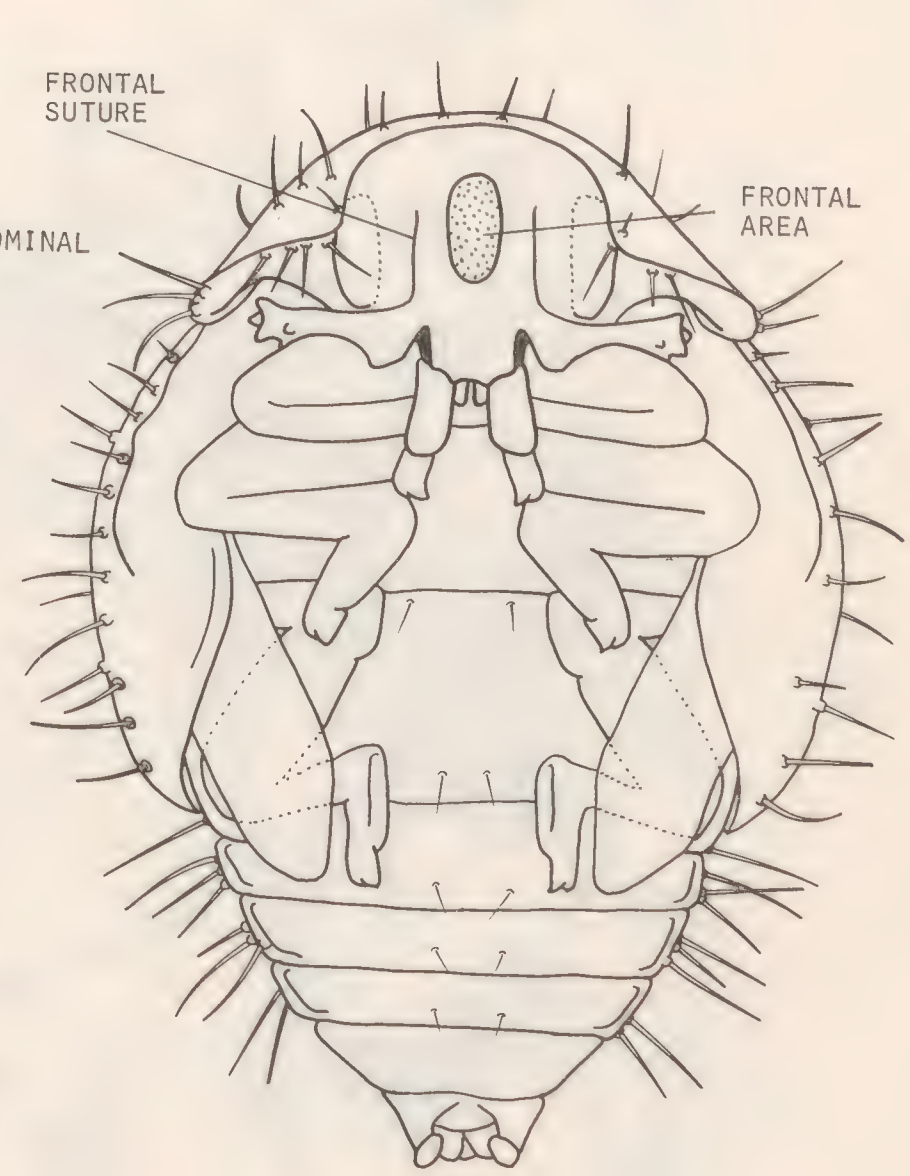

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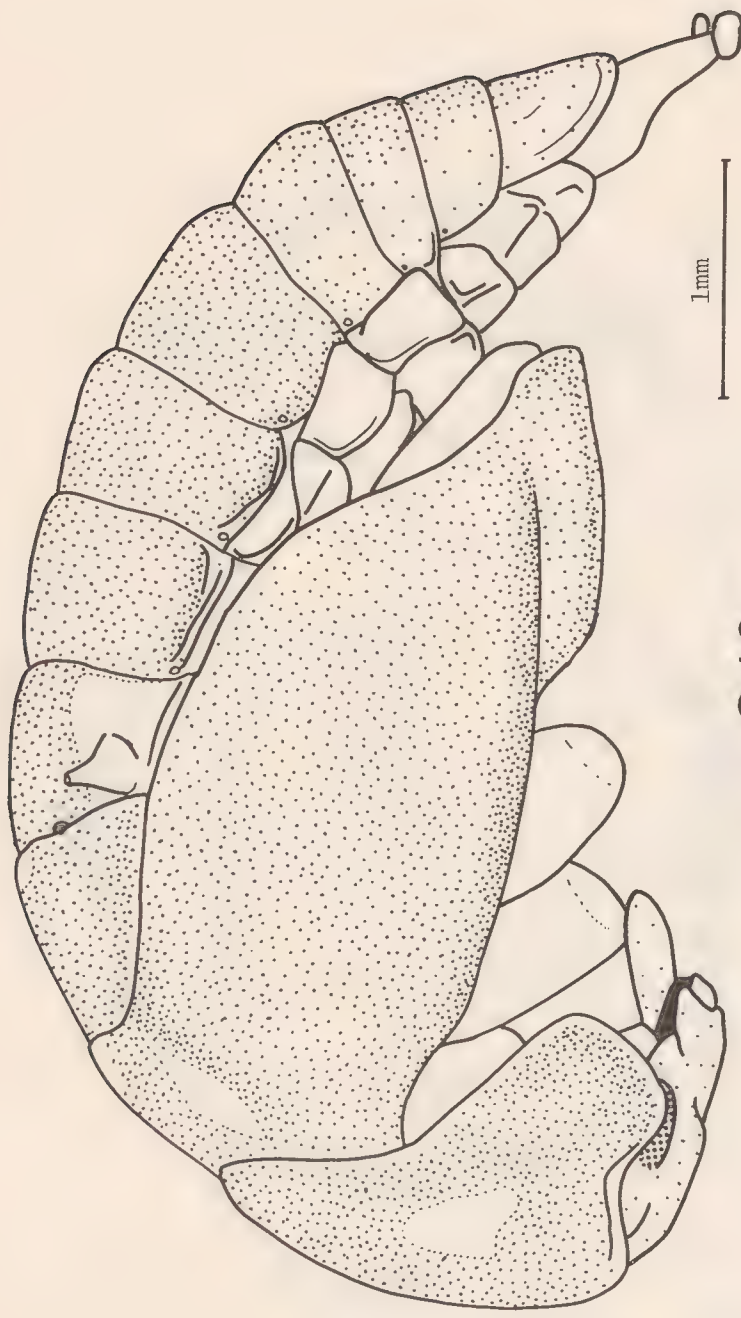
Fig. 235. *Epilachna varivestis,* dorsal aspect.
Fig. 236. *Thalassa montezumae,* dorsal aspect.
Fig. 237. *Stethorus atomus,* dorsal aspect.
Fig. 238. *Stethorus atomus,* dorsal aspect.



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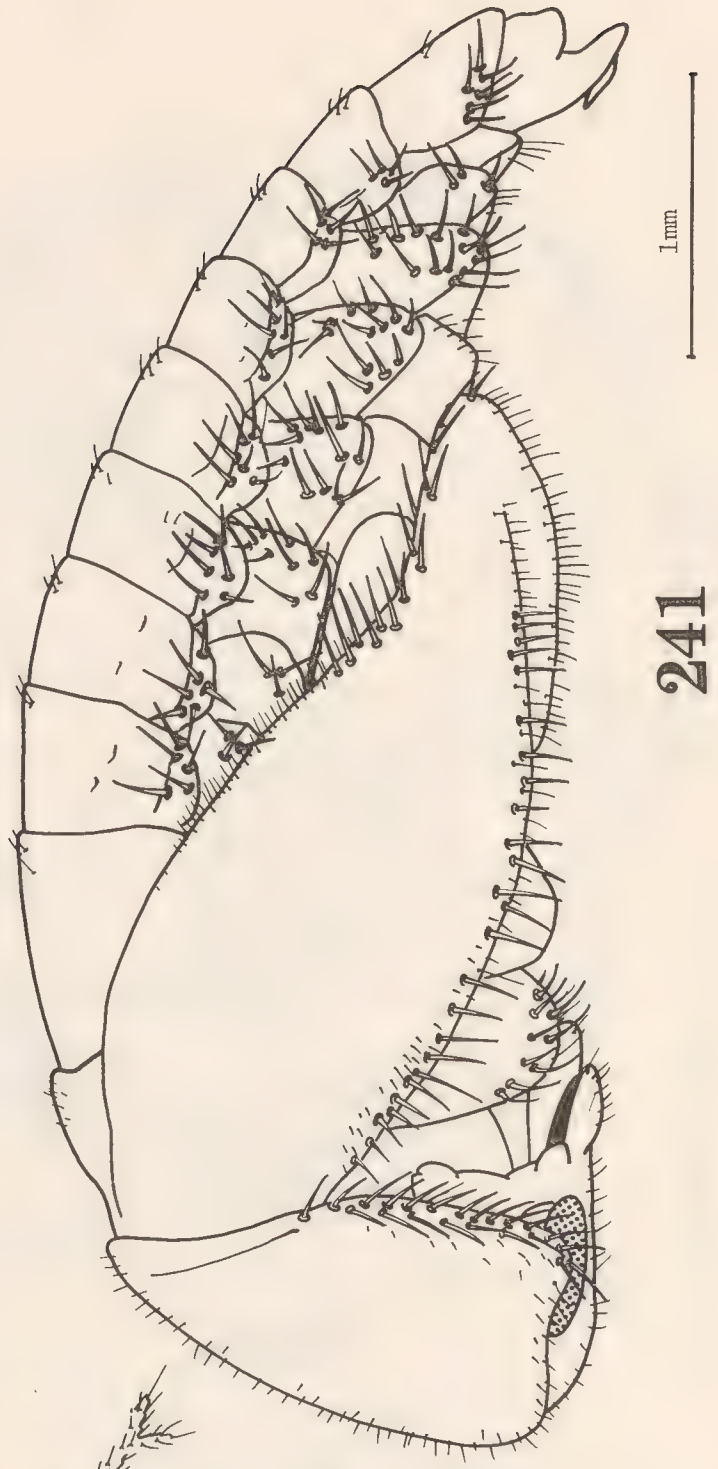

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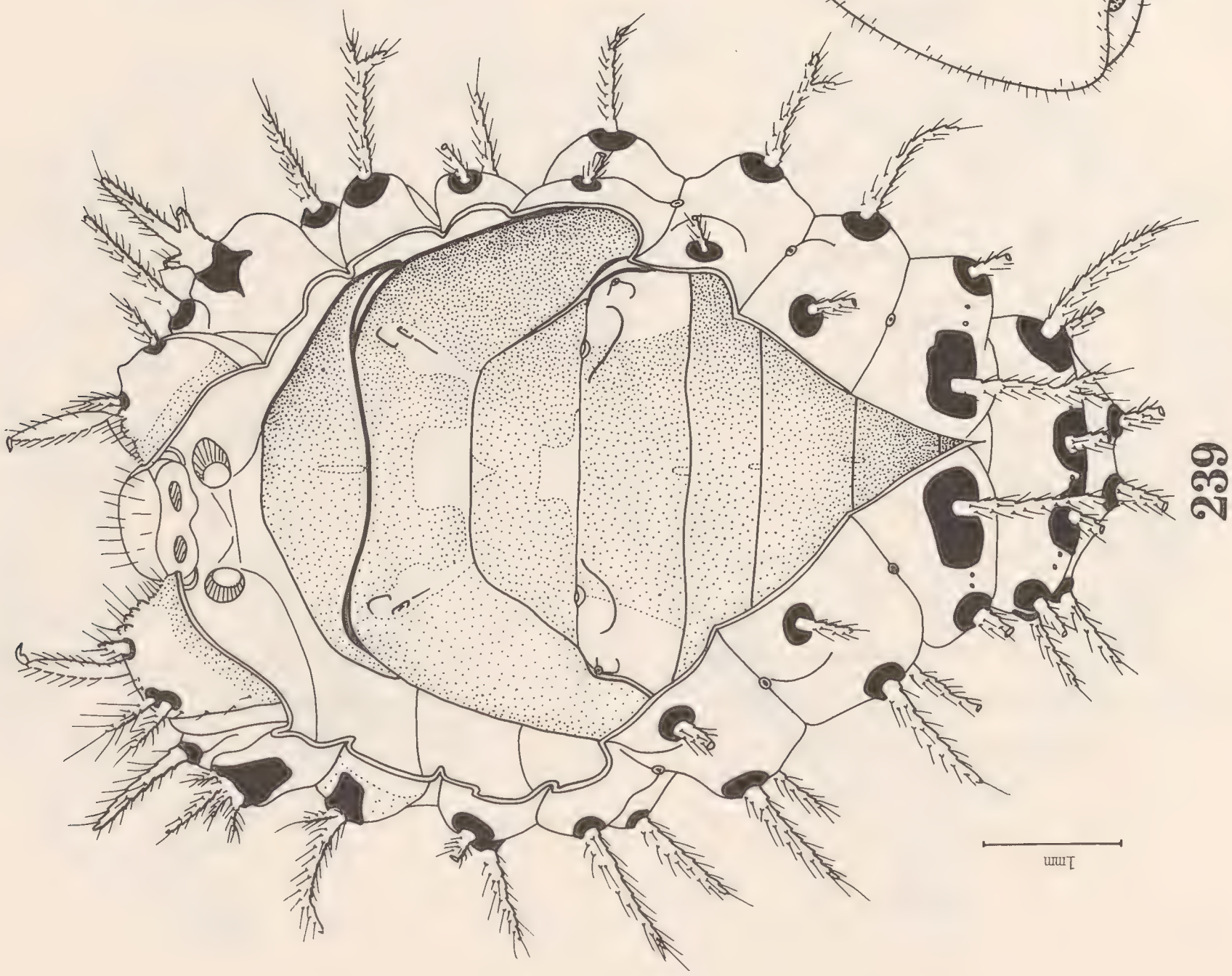

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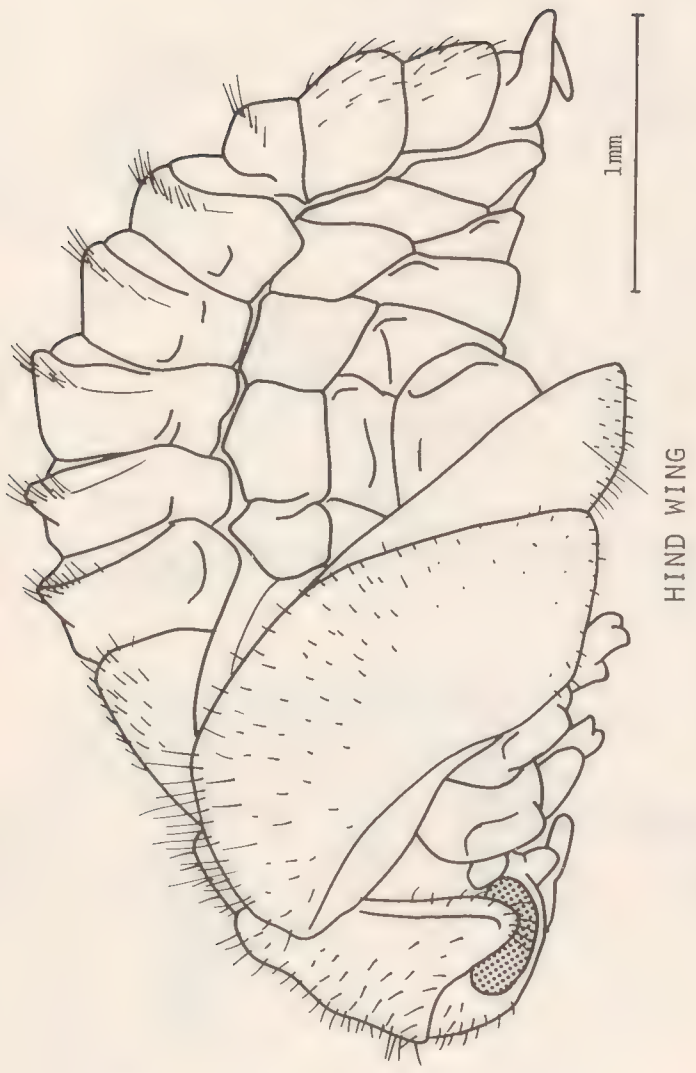
Fig. 239. *Axion plagiatum*, dorsal aspect.
Fig. 240. *Axion plagiatum*, lateral aspect.
Fig. 241. *Cryptolaemus montrouzieri*, lateral aspect.



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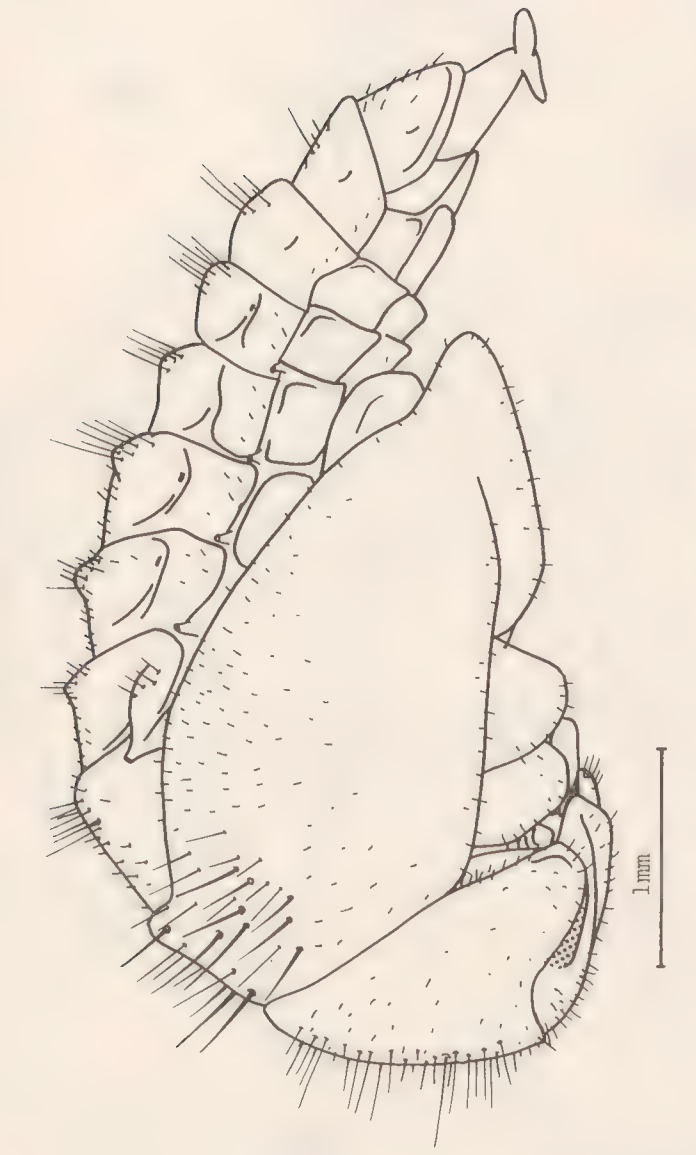

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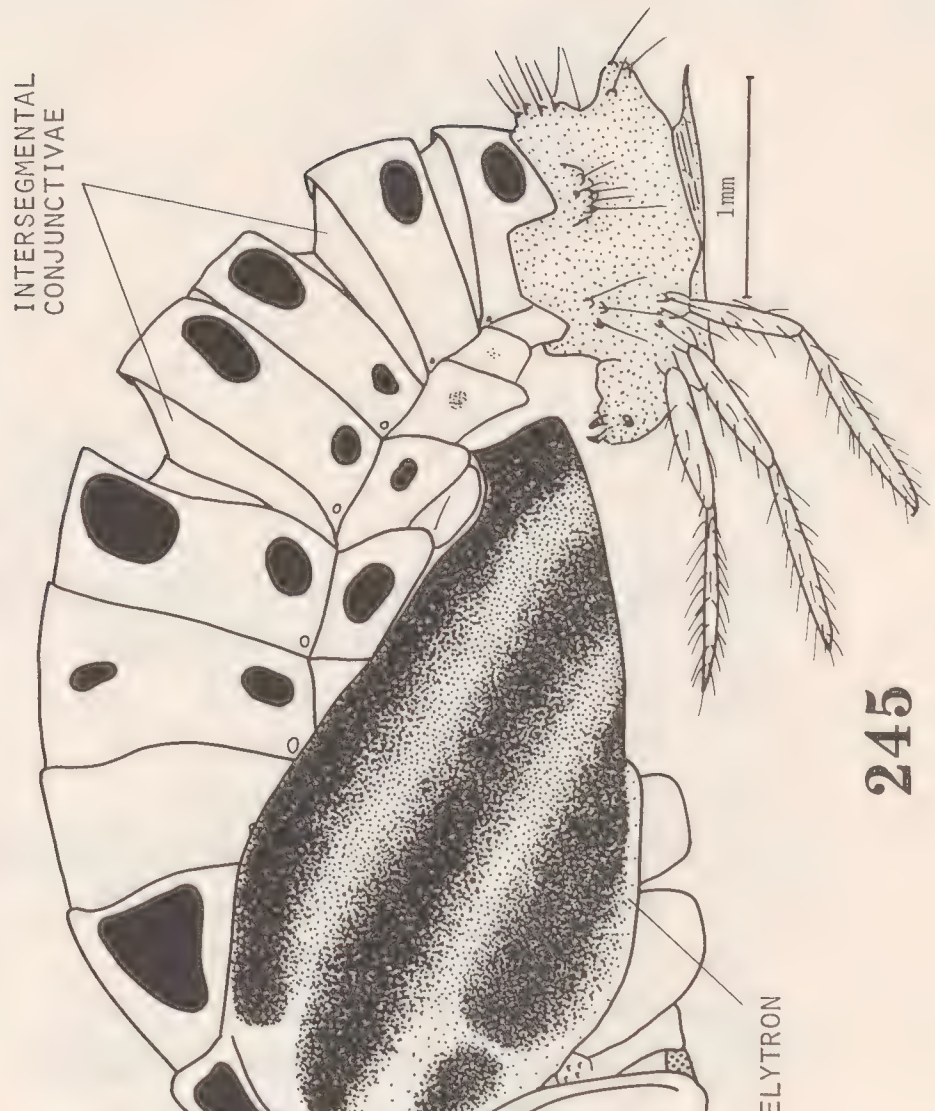

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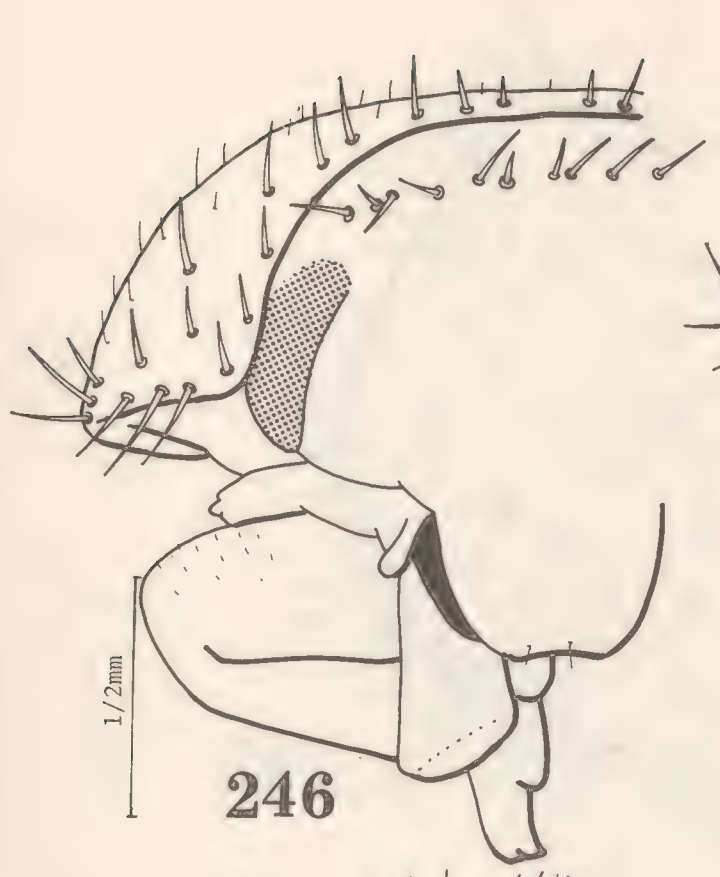
Fig. 242. *Chilocorus bivulnerus*, lateral aspect.
Fig. 243. *Rodolia cardinalis*, lateral aspect.
Fig. 244. *Hippodamia convergens*, lateral aspect.
Fig. 245. *Olla abdominalis*, lateral aspect.

Figs. 246-249: Frontal aspect of the prothoracic and cephalic portion of *Hyperaspis* pupae.
Fig. 246. *Hyperaspis oculaticauda*
Fig. 247. *Hyperaspis postica*
Fig. 248. *Hyperaspis octavia*
Fig. 249. *Hyperaspis lateralis*
Figs. 250-258: Ventral aspect of right urogomphus of *Hyperaspis* pupae.
Fig. 250. *Hyperaspis psyche*
Fig. 251. *Hyperaspis octavia*
Fig. 252. *Hyperaspis cincta*
Fig. 253. *Hyperaspis quadrioculata*
Fig. 254. *Hyperaspis oculaticauda*
Fig. 255. *Hyperaspis postica*
Fig. 256. *Hyperaspis postica*
Fig. 257. *Hyperaspis quadrivittata*
Fig. 258. *Hyperaspis quadrivittata,* ventrolateral aspect.
Figs. 259-262: Left elytron of *Hyperaspis* pupae
Fig. 259. *Hyperaspis octavia*
Fig. 260. *Hyperaspis oculaticauda*
Fig. 261. *Hyperaspis psyche*
Fig. 262. *Hyperaspis quadrivittata*



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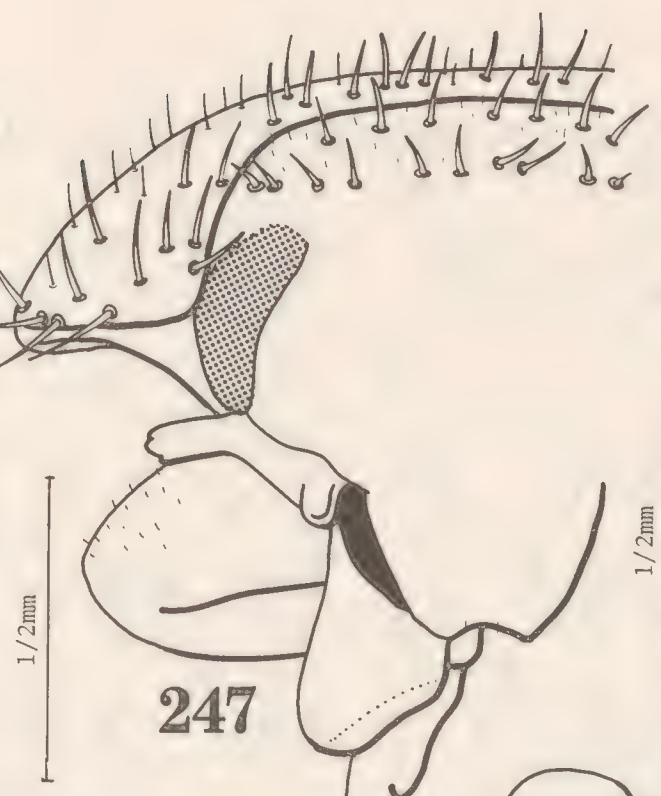

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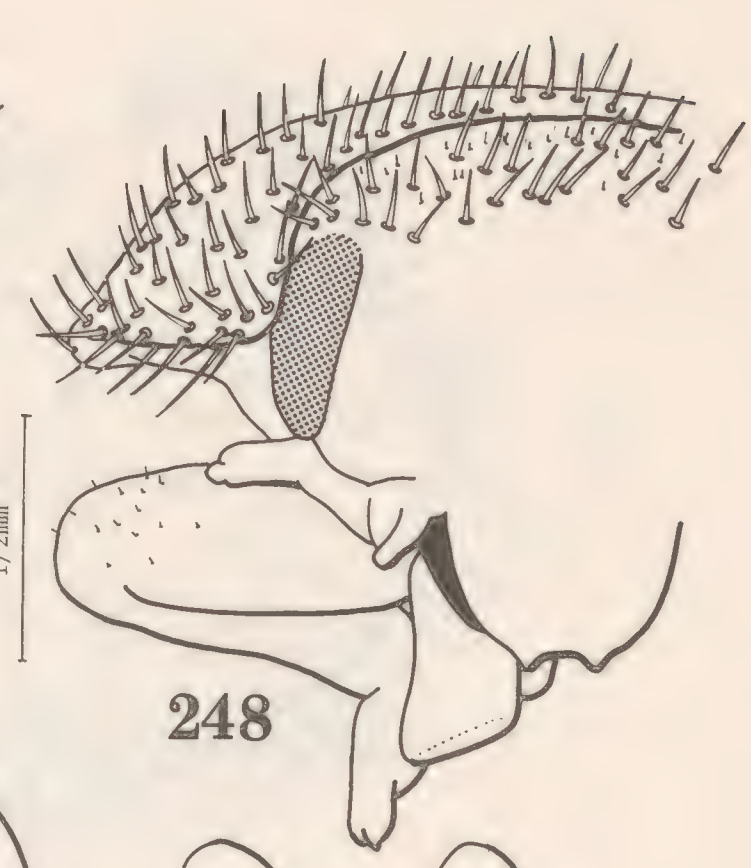

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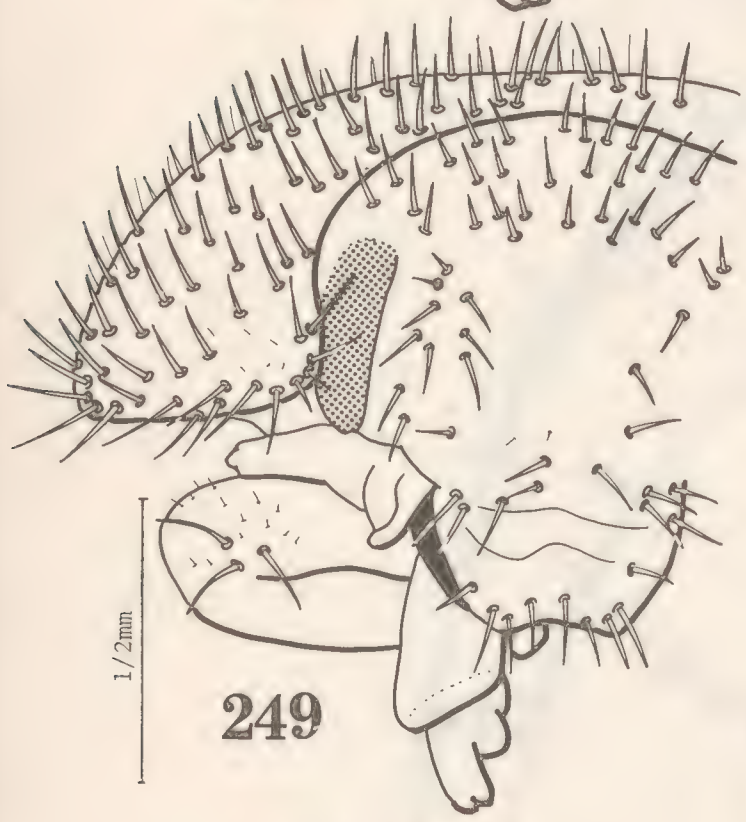

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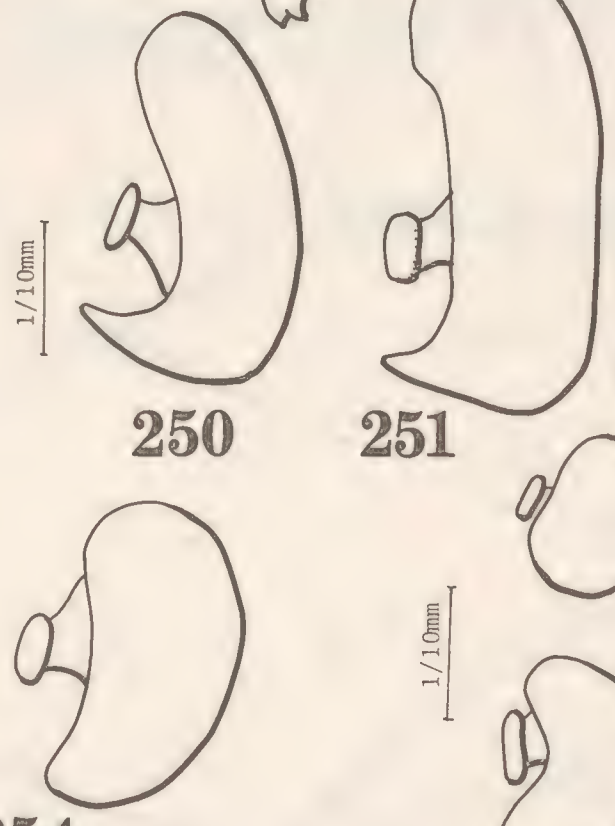

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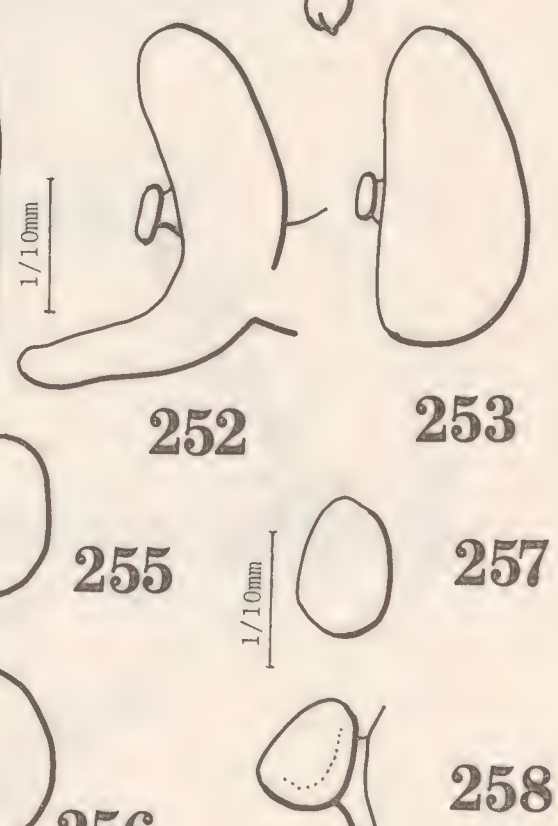

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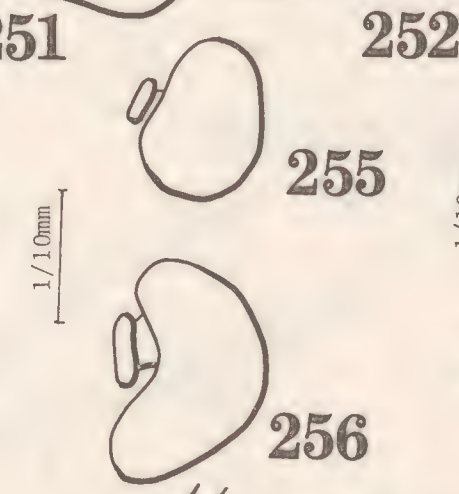

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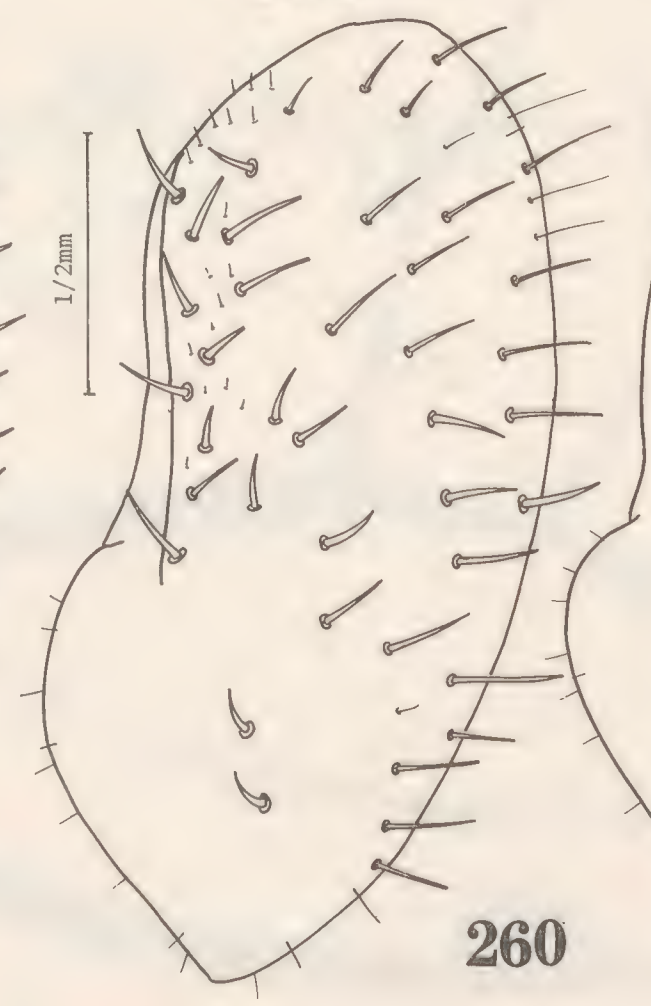

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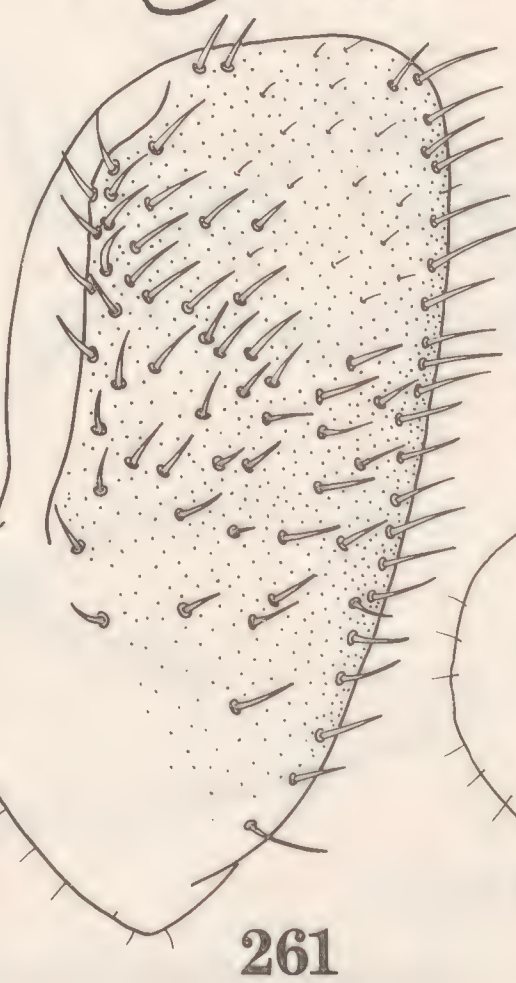

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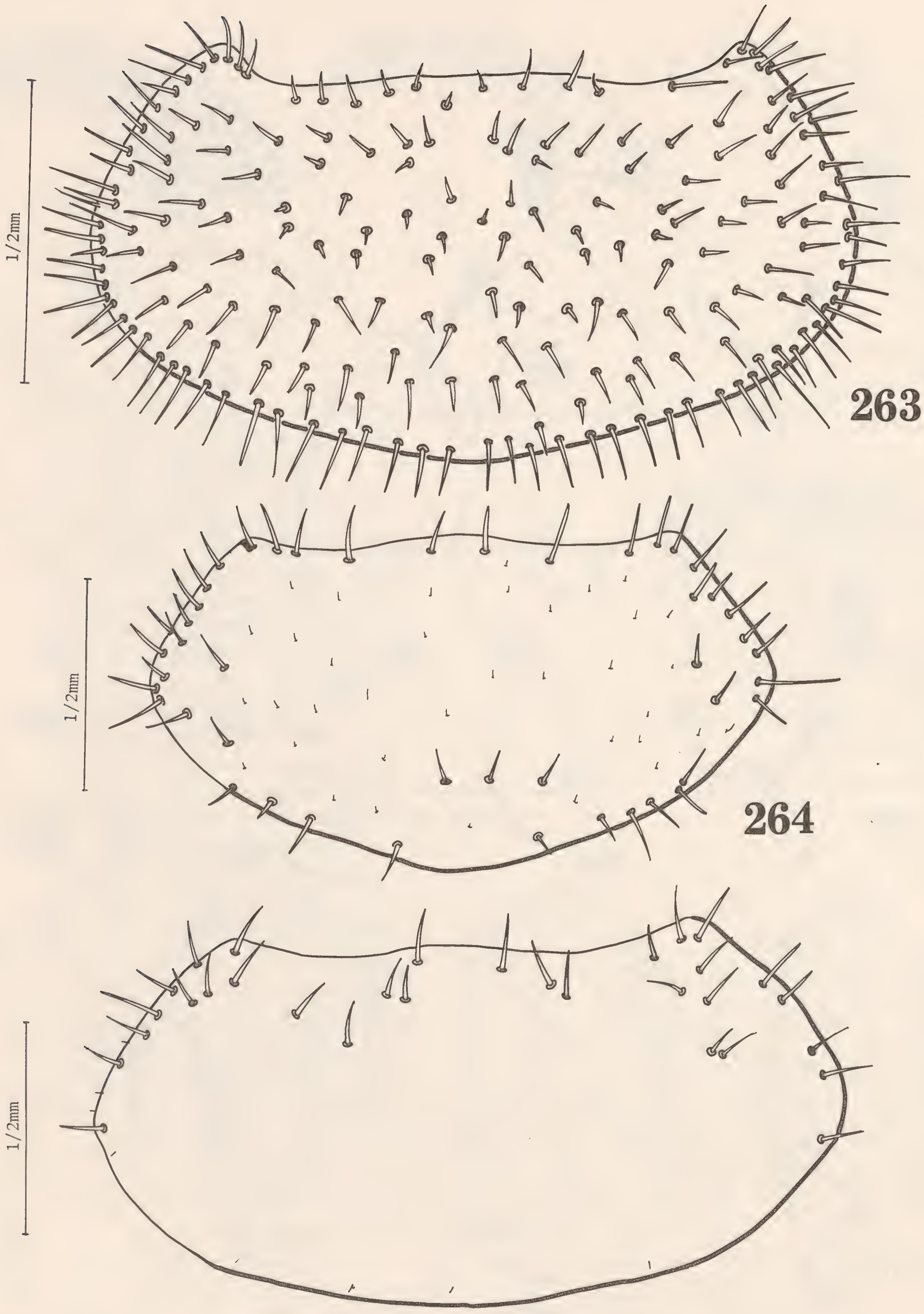

Figs. 263-265: Pronotum of *Hyperaspis* pupae.
Fig. 263. *Hyperaspis quadrivittata*
Fig. 264. *Hyperaspis oculaticauda*
Fig. 265. *Hyperaspis quadrioculata*

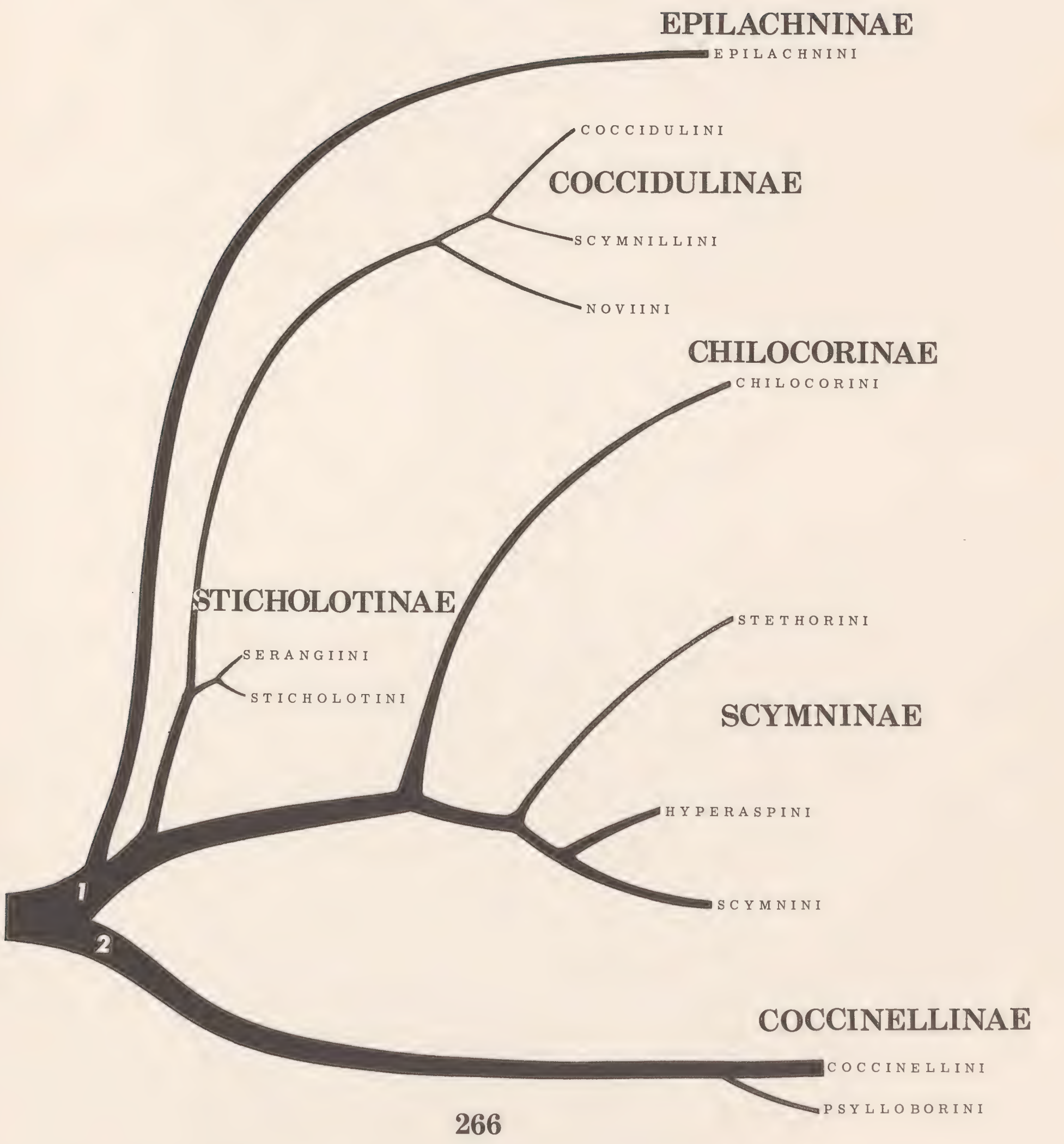

Fig. 266. Phylogenetic diagram of the Coccinellidae suggested by the additional use of pupal characters.